2023-27
POWERLINK QUEENSLAND REVENUE PROPOSAL

Project Pack – PUBLIC

CP.02817
Teebar Creek Secondary Systems Replacement

CP.02817 – Teebar Creek Secondary Systems Replacement

Project Status: Not Approved

1. Network Requirement

The 275/132kV Teebar Creek Substation, approx. 50km west of Maryborough, was established in 2007. The substation is an essential bulk supply point for load and renewable generation connection in the Wide Bay area, such as Maryborough and Susan River Solar Farm. An outage of this asset would put up to 220MW of power and up to 3,600MWh of energy per day at risk[2].

A Condition Assessment (CA) carried out in May 2020 identified that most secondary system assets will reach the end of their technical service lives by 2028[1]. The equipment is, or is becoming, obsolete with no support from the manufacturer and limited spares available. Beyond their 20 year nominal service life, secondary systems suffer increased failure rates. Increasing failure rates, along with the increased time to rectify the faults due to equipment obsolescence, significantly affects the availability and reliability of these systems. There is therefore a need for Powerlink to address this emerging risk to ensure ongoing compliance with Schedule 5.1.9(c) of the National Electricity Rules (NER) and AEMO's Power System Security Guidelines (V95, 2019).

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

2. Recommended Option

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

The current recommended option is to replace all at-risk secondary systems at Teebar Creek Substation by 2028[2].

The following options were considered but not proposed:

- Do Nothing – rejected due to non-compliance with reliability obligations.
- Reinforcing supply from Gin Gin and Woolooga Substations – not recommended due to exceedance of thermal limits and unacceptable levels of voltage drop.
- Non-Network Option parameters identified – at present no viable non-network option has been identified.

Figure 2-1 shows the current recommended option reduces the forecast risk monetisation profile of the Teebar Creek Substation secondary systems to less than $100k per annum after 2028. The recommended option will extend the asset life by 20 years.

Where a 'Do Nothing' scenario is adopted, the forecast level of risk associated with the asset rapidly escalates from less than $100k per annum in 2027 to an estimated just under $1m per annum in 2028 and continues to rise each year thereafter. The significant increase in risk cost in 2028 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].

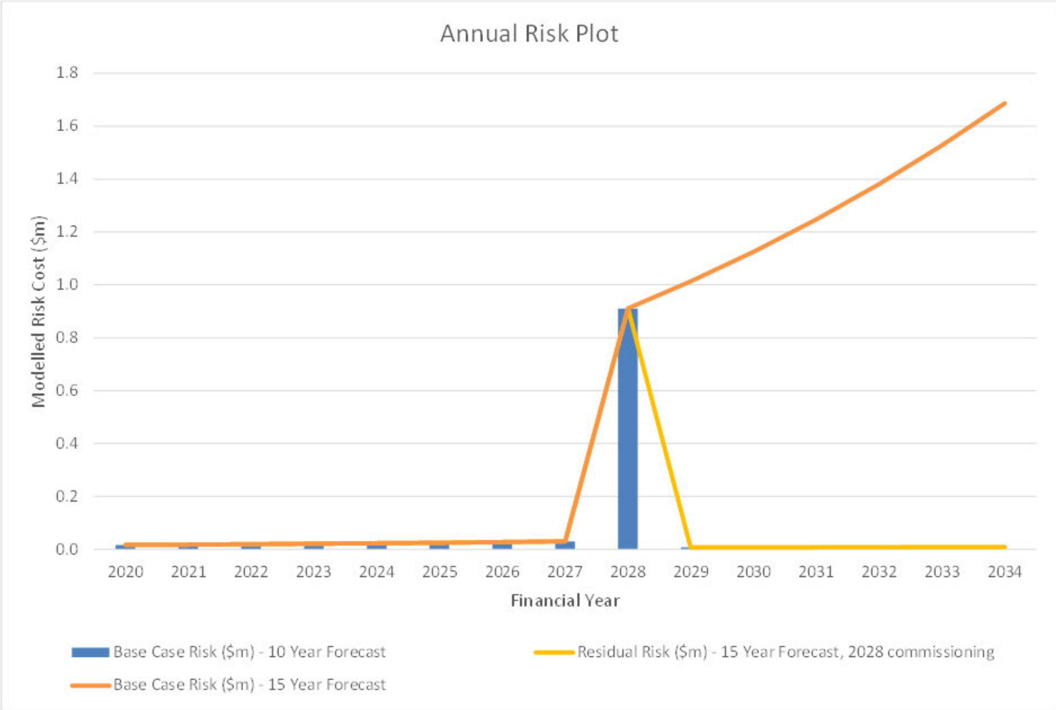

Figure 2-1 Annual Risk Monetisation Profile (Nominal)

3. Cost and Timing

The estimated cost to replace the 275/132kV secondary systems at Teebar Creek Substation is $18.6m ($2019/20 Base)[5].

Target Commissioning Date: December 2027

4. Documents in CP.02817 Project Pack

Public Documents

1. Secondary Systems Condition Assessment Report – H063 Teebar Creek 275kV / 132kV Substation
2. CP.02817 – H063 Teebar Creek Secondary Systems Replacement – Planning Statement
3. Base Case Risk Cost Summary Report CP.02817 Teebar Creek Secondary Systems Replacement
4. Project Scope Report CP.02817 Teebar Creek Secondary Systems Replacement
5. Concept Estimate for CP.02817 Teebar Creek Secondary Systems Replacement

Supporting Documents

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

H063 Teebar Creek
275kV / 132kV Substation

Secondary Systems Condition Assessment Report

Document Details			
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1. Introduction

Teebar Creek Substation was established in 2007 as a 275/132kV bulk supply point and provides a 132kV injection into the southern section of the Wide Bay area (Maryborough and Gympie). It consists of two 275kV feeder bays, two 275/132kV transformer bays and two 132kV feeder bays. H063 Teebar Creek secondary systems were commissioned in 2007 and are still in good condition, as inspected in April 2020.

Teebar Creek substation is located on Gigoomgan Road, BROOWEENA, approximately 260km North-West of Brisbane CBD. The substation is comprised of two switchyards, 275kV and 132kV. Teebar Creek's substation primary bays and network elements are listed in Table 1:

Table 1 – Teebar Creek Substation Network Elements					
Local Substation (H063 Teebar Creek)					**Remote Substation**
	Voltage (kV)	**Quantity**	**Bay Designation**	**Operational Element**	
Feeders	275	2	=C02-A10	826	H006 – Gin Gin
			=C05-A10	8850	H005 – Woolooga
	132	2	=D08-A10	7315	T173 ARAMARA (Ergon)
			=D07-A10	7316	T173 ARAMARA (Ergon)
275kV Couplers	275kV	3	=C02-A30	Bay =C02 Coupler	
			=C03-A30	Bay =C03 Coupler	
			=C05-A30	Bay =C05 Coupler	
132kV Bus Coupler	132kV	1	=D03-A10	1-2 Bus Coupler	
Capacitor Banks		0			
Reactors		0			
Transformers	275/132	2	=C02-A20 =D04-A10	T1 TFMR	132 kV Bay = D04
			=C03-A20 =D09-A10	T2 TFMR	132 kV Bay = D09
Busbars	275	2	=KC1	1 Bus	
			=KC2	2 Bus	
	132	2	=KD1	1 Bus	
			=KD2	2 Bus	

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

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

[redacted]

Figure 1 – 275kV / 132kV Teebar Creek Substation Electrical Single Line Diagram

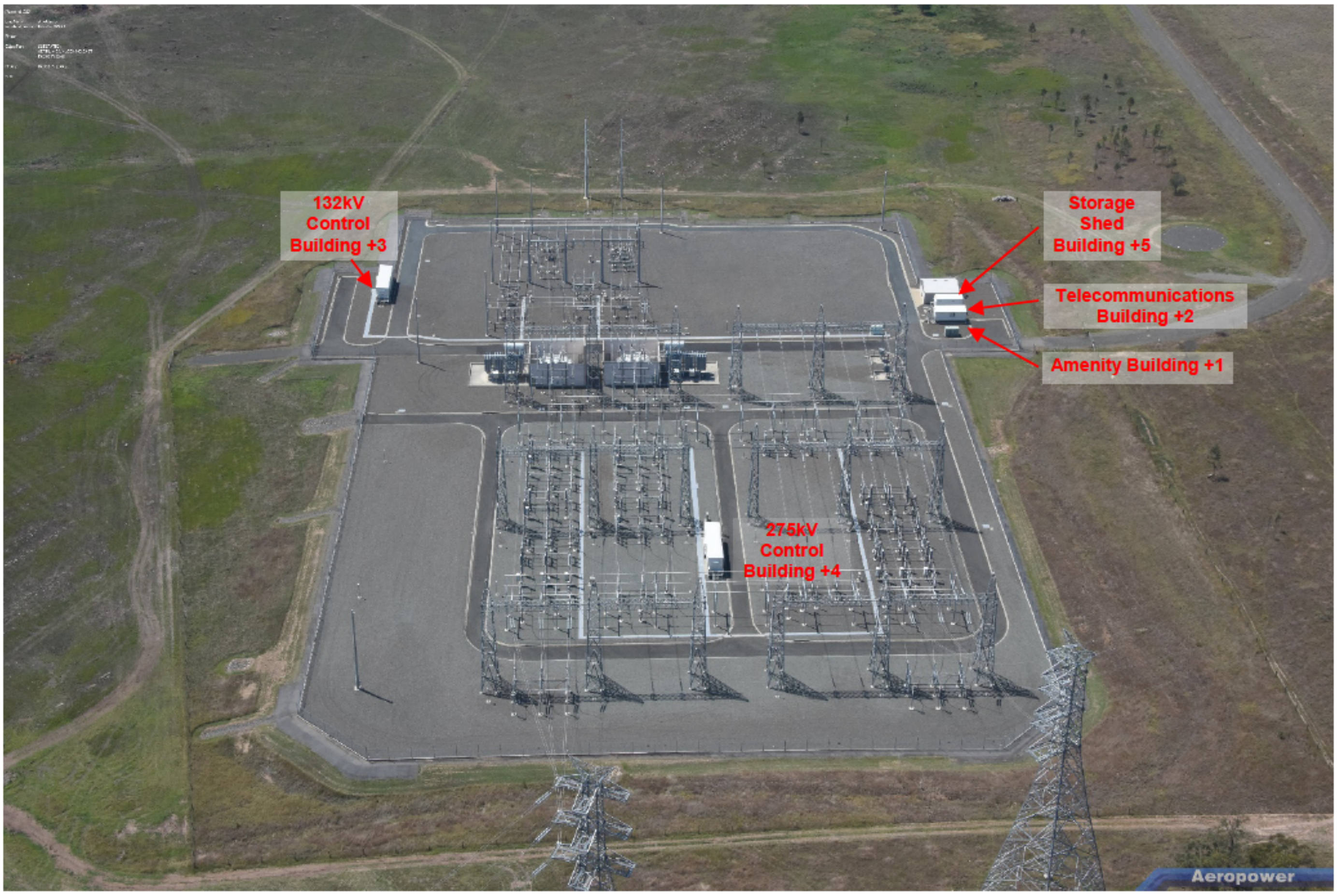


Figure 2 – 275 kV / 132kV Teebar Creek Substation Aerial View

2. Inclusions and Exclusions

2.1 Inclusions

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

- Secondary system cables – All cables that are associated with secondary systems and equipment, including:
  - Cables between control and protection panels and termination racks,
  - Cables between termination racks and yard marshalling kiosks, AC and DC kiosks.
- OpsWAN panels, system and equipment,

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

2.2 Exclusions

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

- Condition of control buildings and associated light and power circuits,

  Civil structures, cable trenches and foundations,
- AC auxiliary supply systems (> 230VAC), including transformers, diesel generators and building power and light circuits,
- Substation flood lights,
- Primary equipment and associated components e.g. transformer and circuit breaker control cubicles,
- Primary equipment kiosks and associated components, e.g. Power transformer, circuit breaker control kiosks.
- Cables from secondary systems outdoor kiosks (e.g. bay marshalling kiosks) to primary plant control kiosks,
- Cables from primary plant control kiosks to primary plant equipment,
- Telecommunication assets, including 50VDC batteries and chargers.

3. Condition Assessment Principles and Methodology

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

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

The desktop assessment formulates equipment health indices based on the optimisation of risk, cost and measured performance of Powerlink' s secondary assets since 1999. Equipment health index is the key condition measurement for each equipment in service. The Health Index methodology takes into account failure rate of individual equipment makes and models, calculated based on recorded operational data (SAP and RIN), environmental conditions where the equipment is installed and the mean physical ages of a group of equipment at the bay and system (fleet) level.

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. Equipment with a health index close to ten (10) represent only 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, as detailed in the Appendix section based on their health indices and condition assessment data.

4. Buildings

4.1 Substation Secondary Systems Buildings

Teebar Creek substation secondary systems are housed in two (2) demountable control buildings +3, and +4, except a small quantity of OpsWAN equipment are still housed in the communication equipment room in building +1. Buildings +3 and +4, which are located within 132kV and 275kV switchyards, are dedicated for 132kV and 275kV secondary systems respectively. All demountable buildings, including amenity, telecommunications, secondary systems buildings, are air-conditioned and clean. All buildings are located within the substation perimeter fence, including the work shed (building +5). Details of Substation buildings are summarised in Table 2.

Table 2 – Teebar Creek Substation Buildings

Building Description	Designation	Functional Use	Spare Sec Sys Panel Spaces
Demountable Building +1	+1	Some OpsWAN equipment and amenities	N/A
Demountable Telecommunications Building +2	+2	OpsWAN Server Telecommunications 50V X&Y Batteries and Chargers	N/A
Demountable 132kV Secondary System Building +3	+3	132kV 1 Bus =KD1 (1BZ CBF BT) 132kV 2 Bus =KD2 (2BZ CBF BT) Sec Sys Bays =D03, =D04, =D07, D08 & D09, Revenue Meters, Mux Communications Common RTU & OpsWAN 125V X&Y Batteries and Chargers	14
Demountable 275kV Secondary System Building +4	+4	275kV 1 Bus =KC1 (1BZ CBF BT) 275kV 2 Bus =KC2 (2BZ CBF BT) Sec Sys of Diameters =C02, =C03 & =C05 Mux Communications SCADA, LCF & OpsWAN, 125V X&Y Batteries and Chargers	13
Work shed	+5	Maintenance Workshop	N/A

(a) Amenity Building +1 and Minor OpsWAN Equipment

(b) Telecommunication Building and OpSWAN Server +2

(c) 132kV Demountable Control Building +3

(d) 275kV Demountable Control Building +4

Figure 3 – H063 275/132kV Teebar Creek Substation secondary systems Buildings

5. Condition Assessment

5.1 Secondary System Outdoor Marshalling Kiosks

Switchgears at Teebar Creek substation include conventional and dead-tank hybrid types.

All standalone outdoor marshalling cubicles at Teebar Creek substation were installed when the secondary systems were first established in 2007. They are still in relatively good condition and should last until 2048. However, some internal components such as links, terminals and MCBs have shown signs of deterioration due to dust, heat and humidity environmental conditions. These cubicles have door seals and air inlets covered with mesh grill to protect internal components from dust and vermin. Mesh grill is designed to keep vermin out but cannot keep dust out. Both mesh grill and door seals appear to be made from low quality / unsuitable materials. Some door seals have degraded / disintegrated and should be replaced as part of routine maintenance. Air pollution, e.g. dust can cause internal links and terminals to age prematurely. It is recommended that all outdoor marshalling cubicles be monitored as part of the substation routine inspection to identify any aggressive deterioration of internal components. An operational project (or maintenance work order) should be initiated to tighten up screw terminals and / or replace the degraded internal components if they deteriorate beyond Powerlink's safety standards or pose any safety concerns.

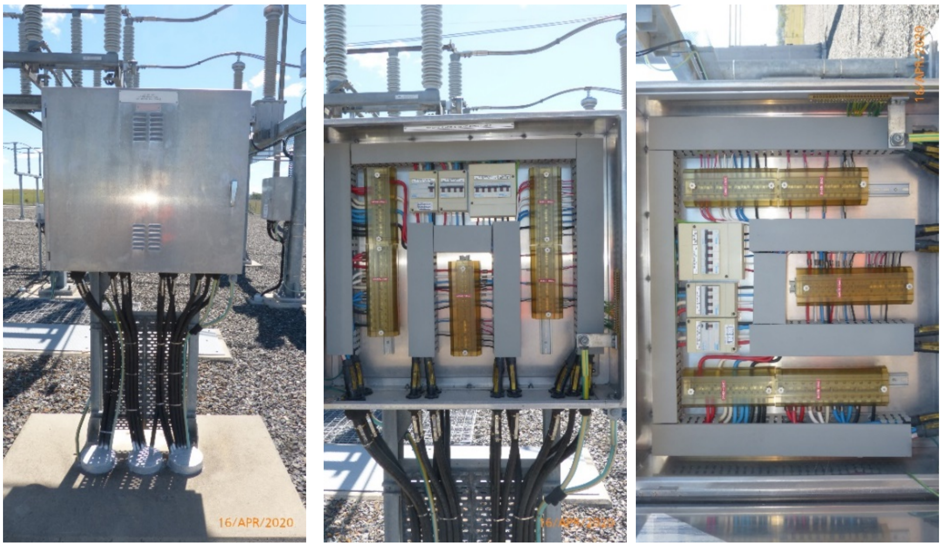
Health Indices of secondary system outdoor marshalling kiosks and recommended replacement timeframe have been detailed in **Appendix A**. Physical appearance of typical outdoor marshalling cubicles and mesh grill air inlets are illustrated below:

- Bay Marshalling kiosk, CT, VT, AC, DC and Interface Kiosks: in Figure 4, include:
  - 132kV 2 Bus CT Marshalling Kiosk (+KD2-A1),
  - 132kV 2 Bus VT Marshalling Kiosk (+KD2-A50),
  - 132kV Bay =D09 Marshalling Kiosk (+D09-A10),
  - 132kV Bay =D07 AC Marshalling Kiosk (+D07-A91),
  - 132kV Bay =D07 DC Marshalling Kiosk (+D07-A92),
  - 275kV Bay =C05-Q10 Feeder 8850 Marshalling Kiosk (+C05-A10)
  - Bay =C03, T2 TFMR Circuit Take Off - 4 VT (+C03-A23)
- Degraded Cubicle mesh grill air inlets: in Figure 5.
  - Degraded cubicle mesh grill air inlets (various bays).

(a) 132kV - 2 Bus Marshalling Kiosk (+KD2-A1)

(b) 132kV - 2 Bus 8 VT Marshalling Kiosk (+KD2-A50)

(c) 132kV Bay =D09 Marshalling Kiosk (+D09-A10)



(d) 132kV Bay =D07 AC Marshalling Kiosk (+D07-A91)

(e) 132kV Bay =D07 DC Marshalling Kiosk (+D07-A92)

(f) 275kV Bay =C05-Q10 Feeder 8850 Marshalling Kiosk (+C05-A10)

(g) Bay =C02, Feeder 8850 Circuit Take Off - 5 VT (+C02-A13)

Figure 4 – Physical appearance of typical outdoor CT, VT, AC, DC and bay marshalling kiosks at Teebar Creek substation

(a) Outdoor Marshalling Cubicle Doors with Unsuitable Mesh Filters and Door Seal

Figure 5 – Physical appearance of typical outdoor marshalling kiosks' unsuitable mesh filters and door seal at Teebar Creek substation

5.2 Outdoor Secondary System Cables

The majority of control and protection cables were terminated directly between secondary systems indoor panels and outdoor marshalling cubicles – no building termination racks. Visual inspection of these cables indicated they are still in good condition, as shown in Figure 6, and can be kept in service until 2048.

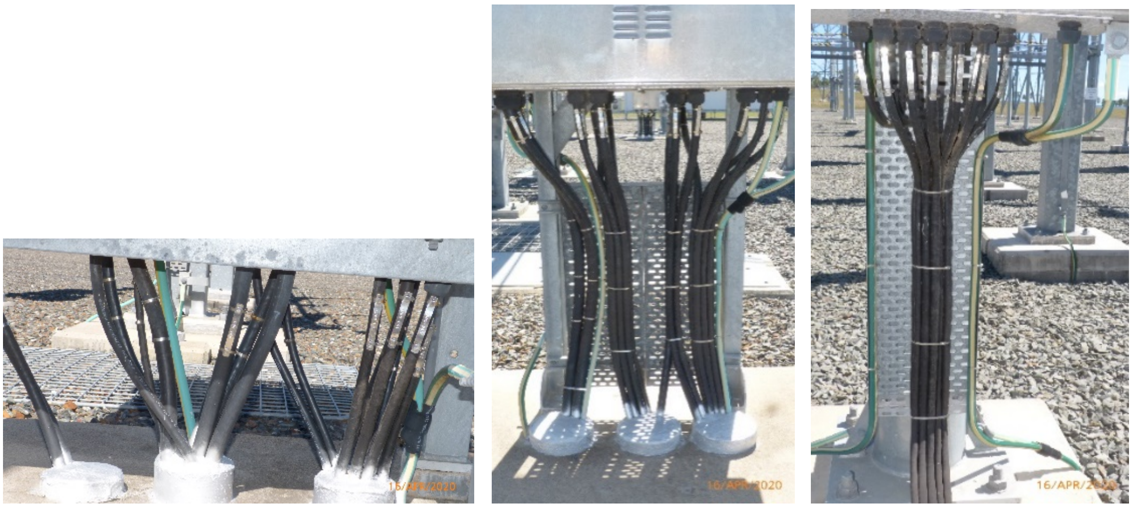


Figure 6 – Physical Appearance of Typical Outdoor Secondary System Cables

5.3 Indoor Termination Racks / Yard Interface Cubicle

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

5.4 Indoor Secondary System Cables

All cables inside the control buildings are considered to be in good condition as they have been in clean and air-conditioned environment since installed in 2007. The replacement of indoor cables is deemed unnecessary until 2048.

5.5 Control and Protection Systems

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

5.5.1 Secondary Systems Panels

Secondary systems panels, including auxiliary parts e.g. links, terminals and internal wiring were installed in 2007. Secondary systems panels, internal wirings, links and terminals, have been kept in clean and air-conditioned environment, can be kept in service until 2048.

132kV Buszone | T1 LV (132kV) | Feeder 7316 | 132kV Bus Coupler

(a) 132kV Indoor Secondary Systems Cubicles

275kV BusZone | Feeder 826 (Gin Gin) | T1 HV (275kV) | 275kV Bus Coupler

(b) 275kV Indoor Secondary Systems Cubicles

Figure 7 – Typical Indoor Secondary Systems Panels at Teebar Creek Substation

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

5.5.2.1. Control, Protection, Auxiliary, Ancillary Equipment

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

Figure 8 – Teebar Creek Substation Typical Indoor Secondary System Equipment (2007)

5.5.2.2. Revenue Metering Panels

Teebar Creek Substation revenue-metering panel, including auxiliary parts e.g. links, terminals and internal wiring was installed in 2007 and currently still in good condition. Panels, internal wirings, links and terminals can be kept service until 2048.

Figure 9 – Teebar Creek substation typical revenue metering panels

5.5.2.3. Revenue Metering Equipment

Teebar Creek Substation revenue metering equipment were installed in 2007. Revenue meters should only be replaced as part of the secondary system replacement project, recommended by 2028.

Figure 10 – Teebar Creek substation typical revenue meters

5.5.2.4. OpsWAN Systems and Equipment

OpsWAN systems and equipment at this site were installed in 2007. OpsWAN systems are still functioning and have an important role in operation and maintenance efficiencies. They are considered as auxiliary components of the power system. Their condition and performance generally do not have material impacts on the performance, reliability and availability of secondary systems and the power system.

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

+2 Master OpsWAN | +3 OpsWAN & Common RTU | +4 SCADA, LCF & OpsWAN

Figure 11 – Teebar Creek Substation OpsWAN Panel

Figure 12 – Teebar Creek Substation Typical OpsWAN Equipment

5.5.3 Auxiliary Supply

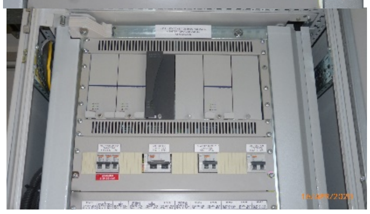
5.5.3.1. AC Auxiliary Supply

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

5.5.3.2. DC Batteries and Chargers

Teebar Creek Substation secondary systems have two (2) sets of 125VDC X and Y batteries and associated chargers installed in 2007 as detailed in the Appendix A. Generally, there is one set of duplicated batteries and chargers per secondary system building. According to the current requirements of secondary systems and telecoms asset strategies, substation DC batteries' and charger's technical service life are now set at 12 and 20 years respectively. Batteries, chargers and monitors at Teebar Creek Substation should be replaced as per recommendations in Appendix A.






(Buildings +3 – Chargers, Monitors, DC Distribution 2007, Batteries 2007)

(Buildings +4 – Chargers, Monitors, DC Distribution 2007, Batteries 2007)

Figure 13 – Teebar Creek substation secondary systems batteries, chargers, monitors and DC distribution

6. Secondary Systems Asset Strategies Recommendations

Recommendations below have been based on the replacement timing (condition based timing) of individual equipment Health Indices (HIs) in Appendix A. It represents secondary system asset strategies view for consideration only, not mandatory. It is important that the responsible project team considers these recommendations in light of Powerlink delivery solutions, staging, resources and network outages to achieve safe and sustainable project delivery cost.

Table 3 – Recommended Asset Replacement Timing and Options – Building +3										
Indoor Sec Sys Panels (14 spare panel spaces)						Possible Options	Outdoor Kiosks (Excl. Primary plant)			
ID	Functions		Panel	Equipment	Cables		ID	Functions	Panel	Cables
+3A1	132kV 1 Bus Zone CBF BT		2048	2028	2048	A, B, C	+KD1-A1	132kV - 1 Bus MK	2048	2048
							+KD1-A50	132kV - 1 Bus, 7 VT	2048	2048
+3A2	132kV 2 Bus Zone CBF BT		2048	2028	2048	A, B, C	+KD2-A1	132kV - 2 Bus MK	2048	2048
							+KD2-A50	132kV - 2 Bus, 8 VT	2048	2048
+3A5	132kV - 1-2 Bus Section CB 4112 (=D03)		2048	2028	2048	A, B, C	+D03-A10	Bay =D03 MK	2048	2048
							+D03-A92	Bay =D03 DC	2048	2048
							+D03-A91	Bay =D03 AC	2048	2048
+3A6	T1 TFMR (275/132kV) LV CB 4412 (=D04), 9VT		2048	2028	2048	A, B, C	+D04-A10	Bay =D04 MK	2048	2048
							+D04-A14	T1 TFMR LV 9 VT	2048	2048
+3A7	Feeder 7316 To T173 ARAMARA (Ergon) CB73162 (=D07), 11VT		2048	2028	2048	A, B, C	+D07-A10	Bay =D07 MK	2048	2048
							+D07-A92	Bay =D07 DC	2048	2048
							+D07-A91	Bay =D07 AC	2048	2048
							+D07-A14	Feeder 7316 11 VT	2048	2048
+3A8	Feeder 7315 To T173 ARAMARA (Ergon) CB73152 (=D08), 12VT		2048	2028	2048	A, B, C	+D08-A10	Bay =D08 MK	2048	2048
							+D08-A14	Feeder 7315 12 VT	2048	2048
+3A9	T2 TFMR (275/132kV) LV CB 4422 (=D09), 10VT		2048	2028	2048	A, B, C	+D09-A10	Bay =D09 MK	2048	2048
							+D09-A14	T2 TFMR LV 10 VT	2048	2048
+3B1	Building +3 (132kV) -CommonRTU & OpsWAN		2048	2028	2048	B, C				
+3B2	Building +3 - 132 kV Multiplex Communications		Please Consult Telecommunication Asset Strategies							
+3B3	Feeders 7315, Feeder 7316 Revenue Meters		2048	2028	2048	A, B, C				
+3C1, +3C2, +3C3, +3C4	Building +3 - 125VDC (X & Y) Batteries, Monitors and Chargers	X Battery		2019		B,C				
		Y Battery		2019		B,C				
		X DC Monitor & Charger		2028		B,C				
		Y DC Monitor & Charger								
		DC Distribution board								

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

Indoor Sec Sys Panels (13 spare panel spaces)					Possible Options	Outdoor Kiosks (Excl. Primary plant)			
ID	Functions	Panel	Equipment	Cables		ID	Functions	Panel	Cables
+4A1	275kV 1 Bus Zone CBF BT	2048	2028	2048	A, B, C	+KC1-A1	275kV - 1 Bus MK	2048	2048
						+KC1-A50	275kV - 1 Bus, 1 VT	2048	2048
+4A2	275kV 2 Bus Zone CBF BT	2048	2028	2048	A, B, C	+KC2-A1	275kV - 2 Bus MK	2048	2048
						+KC2-A50	275kV - 2 Bus, 2 VT	2048	2048
+4A5	Feeder 826 To H006 GinGin, (=C02-Q10), 5VT	2048	2028	2048	A, B, C	+C02-A10	=C02-Q10 MK	2048	2048
						+C02-A13	Feeder 826, 5VT	2048	2048
+4A6	275kVCoupler CB 5022 (Bay =C02-Q30)	2048	2028	2048	A, B, C	+C02-A30	=C02-Q30 MK	2048	2048
						+C02-A92	Diameter =C02 DC	2048	2048
						+C02-A91	Diameter =C02 AC	2048	2048
+4A7	T1 TFMR (275/132kV) HV CB 5412 (=C02-Q20), 6 VT	2048	2028	2048	A, B, C	+C02-A20	=C02-Q20 MK	2048	2048
						+C02-A23	T1 TFMR HV, 6 VT	2048	2048
+4A9	275kVCoupler CB 5032 (Bay =C03-Q30)	2048	2028	2048	A, B, C	+C03-A30	=C03-Q30 MK	2048	2048
						+C03-A92	Diameter =C03 DC	2048	2048
						+C03-A91	Diameter =C03 AC	2048	2048
+4A10	T2 TFMR (275/132kV) HV CB 5422 (=C03-Q20), 4VT	2048	2028	2048	A, B, C	+C03-A20	=C03-Q20 MK	2048	2048
						+C03-A23	T2 TFMR HV, 4 VT	2048	2048
+4B1	Building +4 (275kV) - Station SCADA (NSCs, LCF), Aux Control, Timing, OpsWAN & Common RTU	2048	2028	2048	B, C				
+4B2	Building +4 - 275 kV Multiplex Communications	Please Consult Telecommunication Asset Strategies							
+4B10	275kVCoupler CB 5052 (Bay =C05-Q30)	2048	2028	2048	A, B, C	+C05-A30	=C05-Q30 MK	2048	2048
						+C05-A92	Diameter =C05 DC	2048	2048
						+C05-A91	Diameter =C05 AC	2048	2048
+4B11	Feeder 8850 To H005 Woolooga, (=C05-Q10), 3VT	2048	2028	2048	A, B, C	+C05-A10	=C05-Q10 MK	2048	2048
						+C05-A13	Feeder 8850, 3VT	2048	2048
+4C1, +4C2, +4C3, +4C4	Building +4 - 125VDC (X & Y) Batteries, Monitors and Chargers: X Battery		2019		B,C				
	Y Battery		2019		B,C				
	X DC Monitor & Charger		2028		B,C				
	Y DC Monitor & Charger								
	DC Distribution board								

Notes:

(i). *Option A: In-Situ (Equipment) Replacement - Replace equipment in existing panel.*
(ii). *Option B: Install new panels in existing building.*
(iii). *Option C: Install new panels in new building.*
(iv). *Unless specified, e.g. Transformer PLCs and some SICUs, all electronic equipment installed inside primary plant control cubicles (e.g. SICU, PASS M0 OLMs) are considered as integral parts of primary plant assets and are not in scope of this report.*
(v). *Innovative replacement solutions should be considered to maximise the use of available spaces in existing building to save cost.*
(vi). *Replacement timing for PASS M0 switchgear and its control cubicles depends on primary plant strategy.*
(vii). *Panel includes chassis, links, terminals and internal wirings.*
(viii). *Powerlink's technical asset life for batteries is 12 years, for chargers and monitors is 20 years.*

7. Conclusion

This report details the conditions of Teebar Creek Substation secondary systems and equipment. The primary objective of the replacement timeframe is to maintain the current network reliability and availability and to minimise operational and compliance risks associated with secondary systems assets at Teebar Creek substation. Secondary systems are recommended to be replaced by the end of calendar year 2028, as per secondary systems asset strategies recommendations.

Degraded door seals and mesh grill air inlets of outdoor marshalling kiosks should be inspected and replaced as part of routine maintenance.

8. Attachments

- **Appendix A** – H063 132/275kV Teebar Creek Substation Secondary Systems Equipment Health Indices and Recommended Asset Placement Replacement Timeframe.
- CIGRE 2018 - B3 - 205 - Modelling Substation control and Protection Asset Condition for Optimal reinvestment Decision Based on Risk, Cost and Performance.
- Powerlink – Asset Risk Management – Framework, ASM-I&P-FRA-A2417558, Powerlink Queensland, 2019.

9. References

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

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

10. Appendix A

APPENDIX A - H063 TEEBAR CREEK 275 / 132KV SUBSTATION SECONDARY SYSTEMS - EQUIPMENT HEALTH INDICES AND RECOMMENDED REPLACEMENT TIMEFRAME

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

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

BAY	C&P PANEL				SECONDARY SYSTEMS EQUIPMENT							X-PROT		Y-PROT		AUX & CTRL		REVENUE METERING		OPSWAN		CABLES (HI)	YARD MARSHALLING KIOSKS (HI)	C&P PANELS (Chassis)	Sec Sys Eqiupment	CABLES	YARD MARSHALLING KIOSKS
Function	Panel Descripion	Panel No.	Year	HI	Functional Loc.	Description	Manufacturer	Model number	Obsolescence (Yes / No)	Spare Qty	Material	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	C&P Panels to HV Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	C&P Panels	Sec Sys Equipment & Auxiliary Components	C&P Panels to HV Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)
132kV - 1 Bus Zone	132kV - 1 Buszone CBF BT	+3A1	2007	3.71	H063-SSS-1BU4-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754	12.06	6.03									3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-1BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	12.06	6.03														
					H063-SSS-1BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690	12.06	6.03														
					H063-SSS-1BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578	12.06	6.03														
					H063-SSS-1BU4-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754			12.06	6.03												
					H063-SSS-1BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			12.06	6.03												
					H063-SSS-1BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690			12.06	6.03												
					H063-SSS-1BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578			12.06	6.03												
275kV - 1 Bus Zone	275kV - 1 Buszone CBF BT	+4A1	2007	3.71	H063-SSS-1BU5-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	10	27351					12.19	6.10					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-1BU5-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754	12.19	6.10														
					H063-SSS-1BU5-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	12.19	6.10														
					H063-SSS-1BU5-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690	12.19	6.10														
					H063-SSS-1BU5-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578	12.19	6.10														
					H063-SSS-1BU5-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754			12.19	6.10												
					H063-SSS-1BU5-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			12.19	6.10												
					H063-SSS-1BU5-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690			12.19	6.10												
					H063-SSS-1BU5-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578			12.19	6.10												
132kV - 2 Bus Zone	132kV - 2 Buszone CBF BT	+3A2	2007	3.71	H063-SSS-2BU4-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754	12.06	6.03									3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-2BU4-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	12.06	6.03														
					H063-SSS-2BU4-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690	12.06	6.03														
					H063-SSS-2BU4-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578	12.06	6.03														
					H063-SSS-2BU4-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754			12.06	6.03												
					H063-SSS-2BU4-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			12.06	6.03												
					H063-SSS-2BU4-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690			12.06	6.03												
					H063-SSS-2BU4-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578			12.06	6.03												
275kV - 2 Bus Zone	275kV - 2 Buszone CBF BT	+4A2	2007	3.71	H063-SSS-2BU5-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	10	27351					12.19	6.10					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-2BU5-XPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754	12.19	6.10														
					H063-SSS-2BU5-XPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689	12.19	6.10														
					H063-SSS-2BU5-XPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690	12.19	6.10														
					H063-SSS-2BU5-XPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578	12.19	6.10														
					H063-SSS-2BU5-YPROT	RELAY DIFF ALSTOM MFAC34 RANGE 25-325VAC	ALSTOM	MFAC34	No	8	13754			12.19	6.10												
					H063-SSS-2BU5-YPROT	RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13	AREVA	MVAJ13	No	18	26689			12.19	6.10												
					H063-SSS-2BU5-YPROT	RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12	AREVA	MVAX12	No	9	26690			12.19	6.10												
					H063-SSS-2BU5-YPROT	RELAY CB FAIL BUS TRIP RACK	RMS	3A111K3	No	29	26578			12.19	6.10												
132kV 1-2 Bus Section	132kV - 1-2 Bus Section CB 4112 (=D03)	+3A5	2007	3.71	H063-SSS-411--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	4	27361					12.06	6.03					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-411--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	12.06	6.03														
					H063-SSS-411--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	Yes	11	25466			12.06	6.03												
T1 TFMR LV	T1 TFMR (275/132kV) LV CB 4412 (=D04)	+3A6	2007	3.71	H063-SSS-441--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.06	6.03					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-441--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	12.06	6.03														
					H063-SSS-441--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	Yes	11	25466			12.06	6.03												
T2 TFMR LV	T2 TFMR (275/132kV) LV CB 4422 (=D09)	+3A9	2007	3.71	H063-SSS-442--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.06	6.03					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-442--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	12.06	6.03														
					H063-SSS-442--YPROT	RELAY CBMAN SEL-351-1 (1A)	SCHWEITZER	SEL-351-1 (1A)	Yes	11	25466			12.06	6.03												
Bay =C02 Coupler	275kVCoupler CB 5022 (Bay =C02-Q30)	+4A6	2007	3.71	H063-SSS-502--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	12.22	6.11									3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-502--YPROT	RELAY CB MGMT SEL 352 1A, 125Vdc, 4U	SCHWEITZER	SEL-352 (1A) (4U)	Yes	5	25441			12.22	6.11												
Bay =C03 Coupler	275kVCoupler CB 5032 (Bay =C03-Q30)	+4A9	2007	3.71	H063-SSS-503--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	12.19	6.10									3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-503--YPROT	RELAY CB MGMT SEL 352 1A, 125Vdc, 4U	SCHWEITZER	SEL-352 (1A) (4U)	Yes	5	25441			12.19	6.10												
Bay =C05 Coupler	275kVCoupler CB 5052 (Bay =C05-Q30)	+4B10	2007	3.71	H063-SSS-505--XPROT	RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE)	GE	C60 (VER 2.93)	Yes	9	26931	12.19	6.10									3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-505--YPROT	RELAY CB MGMT SEL 352 1A, 125Vdc, 4U	SCHWEITZER	SEL-352 (1A) (4U)	Yes	5	25441			12.19	6.10												
T1 TFMR HV	T1 TFMR (275/132kV) HV CB 5412 (=C02-Q20)	+4A7	2007	3.71	H063-SSS-541--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.22	6.11					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-541--XPROT	RELAY DIFF 25-325V 1POLE AREVA MFAC14	AREVA	MFAC14	No	4	12241	12.19	6.10														
					H063-SSS-541--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	GE	T60 (3.48)	Yes	8	27193	12.19	6.10														
					H063-SSS-541--XPROT	RELAY TRANSF O/LOAD GE F35 (2.93)	GE	F35 (2.93)	Yes	6	27194	12.19	6.10														
					H063-SSS-541--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	SEL-387-5 (1A) (3U)	Yes	4	25465			12.19	6.10												
T2 TFMR HV	T2 TFMR (275/132kV) HV CB 5422 (=C03-Q20)	+4A10	2007	3.71	H063-SSS-542--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.19	6.10					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-542--XPROT	RELAY DIFF 25-325V 1POLE AREVA MFAC14	AREVA	MFAC14	No	4	12241	12.19	6.10														
					H063-SSS-542--XPROT	RELAY TRANSF DIFF GE T60 (3.48)	GE	T60 (3.48)	Yes	8	27193	12.19	6.10														
					H063-SSS-542--XPROT	RELAY TRANSF O/LOAD GE F35 (2.93)	GE	F35 (2.93)	Yes	6	27194	12.19	6.10														
					H063-SSS-542--YPROT	RELAY BIASED DIFF SEL-387-5 (1A) (3U)	SCHWEITZER	SEL-387-5 (1A) (3U)	Yes	4	25465			12.19	6.10												
Feeder 7315	Feeder 7315 To T173 ARAMARA (Ergon), CB73152 (=D08), 12VT	+3A8	2007	3.71	H063-SSS-7315-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.06	6.03					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-7315-XPROT	RELAY CURRENT DIFF MICOM P543	MICOM	P543 (+ 2nd Port)	Yes	12	30868	12.06	6.03														
					H063-SSS-7315-YPROT	RELAY DISTANCE SEL-311C (1A)	SCHWEITZER	SEL-311C (1A)	Yes	28	25388			12.06	6.03												
Feeder 7316	Feeder 7316 To T173 ARAMARA (Ergon) CB73162 (=D07), 11VT	+3A7	2007	3.71	H063-SSS-7316-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.06	6.03					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-7316-XPROT	RELAY CURRENT DIFF MICOM P543	MICOM	P543 (+ 2nd Port)	Yes	12	30868	12.06	6.03														
					H063-SSS-7316-YPROT	RELAY DISTANCE SEL-311C (1A)	SCHWEITZER	SEL-311C (1A)	Yes	28	25388			12.06	6.03												

APPENDIX A - H063 TEEBAR CREEK 275 / 132KV SUBSTATION SECONDARY SYSTEMS - EQUIPMENT HEALTH INDICES AND RECOMMENDED REPLACEMENT TIMEFRAME

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

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

BAY	C&P PANEL				SECONDARY SYSTEMS EQUIPMENT							X-PROT		Y-PROT		AUX & CTRL		REVENUE METERING		OPSWAN		CABLES (HI)	YARD MARSHALLING KIOSKS (HI)	C&P PANELS (Chassis)	Sec Sys Eqiupment	CABLES	YARD MARSHALLING KIOSKS
Function	Panel Descripion	Panel No.	Year	HI	Functional Loc.	Description	Manufacturer	Model number	Obsolescence (Yes / No)	Spare Qty	Material	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	Eff. Age	HI	C&P Panels to HV Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	C&P Panels	Sec Sys Equipment & Auxiliary Components	C&P Panels to HV Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)	Yard Marshalling Kiosks (CB, MK, CT, VT, AC, DC, COOLING)
Feeder 826	Feeder 826 To H006 GinGin, (=C02-Q10), 5VT	+4A5	2007	3.71	H063-SSS-826--BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.19	6.10					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-826--XPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	MICOM	P544 (+ 2nd Port)	Yes	9	30869	12.22	6.11														
					H063-SSS-826--XPROT	COMMS INTERFACE UNIT ALSTOM P591	AREVA	P591 (50VDC)	Yes	90	26261	6.95	3.48														
					H063-SSS-826--YPROT	RELAY DISTANCE SEL-421 (1A) (5U)	SCHWEITZER	SEL-421 (1A) (5U)	Yes	7	26126			12.22	6.11												
Feeder 8850	Feeder 8850 To H005 Woolooga, (=C05-Q10), 3VT	+4B11	2007	3.71	H063-SSS-8850-BAYCONT	REMOTE TERMINAL UNIT FOXBORO C50	FOXBORO	C50	Yes	26	27350					12.19	6.10					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-8850-PSSTA	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	DM1200 DIGITAL	Yes	6	17308	12.19	6.10														
					H063-SSS-8850-PSSTB	RFL 9745 PROT SIG DIG I/O 48-125V	RFL ELECTRONICS	9745 DIGITAL	Yes	1	17268	12.19	6.10														
					H063-SSS-8850-XPROT	CURR DIFF RELAY MICOM P544 + 2ND PORT	MICOM	P544 (+ 2nd Port)	Yes	9	30869	12.19	6.10														
					H063-SSS-8850-XPROT	COMMS INTERFACE UNIT ALSTOM P591	AREVA	P591 (50VDC)	Yes	90	26261	6.95	3.48														
					H063-SSS-8850-YPROT	RELAY DISTANCE SCHW'ZER 421-5 1A 24 LED	SCHWEITZER	SEL-421-5 (1A) (5U)	Yes	6	32105			9.00	4.50												
					H063-SSS-8850-PSPITY	DEWAR DM1200 PROT SIG DIG 90-320V SUPPLY	DEWAR	DM1200 DIGITAL	Yes	6	17308			12.19	6.10												
Revenue Meters	Feeders 7315, Feeder 7316 Revenue Meters	+3B3	2007	3.71	H063-SSS-METR-REVMET1	METER KWH/KVARH EDMI 2000-0400 (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							12.06	6.03			3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-METR-REVMET1	METER KWH/KVARH EDMI 2000-0400 (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							12.06	6.03								
					H063-SSS-METR-REVMET2	METER KWH/KVARH EDMI 2000-0400 (REVENUE)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							12.06	6.03								
					H063-SSS-METR-REVMET2	METER KWH/KVARH EDMI 2000-0400 (CHECK)	EDMI	2000-0400 1A Cl 0.5	Yes	49	15879							12.06	6.03								
OpsWAN	Building +1 - Local Control Facilty & OpsWAN		2007	3.71	H063-SSS-NBAY-LCF1	MONITOR TFT	HEWLETT PACKARD	L1740	Yes	0	26738					12.00	10.00					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-NBAY-LCF1	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE	UXO	Yes	0						8.82	7.35										
					H063-SSS-NBAY-OWNTWK1	[redacted]			Yes	1	28417									12.00	10.00						
					H063-SSS-NBAY-OWPRINT	PRINTER	RICOH	MFD AFICIO MP C3004	No	0	37469									2.17	1.81						
OpsWAN	Building +2 (Comms) - Master OpsWAN and Terminal Server	+2A1	2007	3.71	H063-SSS-NBAY-OWNTWK2	[redacted]			Yes	0	27651									12.00	10.00	3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-NBAY-OWNTWK2				Yes	6	27652									12.00	10.00						
					H063-SSS-NBAY-OWSERV2	MONITOR/KEYBOARD	ICP GLOBAL	C-2417B	Yes	0	27630									12.00	10.00						
					H063-SSS-NBAY-OWSERV2	TERMINAL SERVER	ICP ELECTRONICS	3GHZ P4	Yes	5	27636									10.12	8.44						
OpsWAN	Building +3 (132kV) -CommonRTU & OpsWAN	+3B1	2007	3.71	H063-SSS-NBAY-LCF3	MONITOR TFT	HEWLETT PACKARD	L1740	Yes	0	26738					12.00	10.00					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-NBAY-LCF3	LOCAL CONTROL FACILITY PC X TERMINAL	WYSE	UXO	Yes	0						8.82	7.35										
					H063-SSS-NBAY-OWINVRT3	INVERTER 125VDC/240VAC 1500W	LATRONICS	IRM15120	No	2	25941									12.06	6.03						
					H063-SSS-NBAY-OWNTWK3	SWITCH 8PORT	RUGGEDCOM	RS8000A-HI-MM-MS	Yes	7	27400									12.00	10.00						
					H063-SSS-NBAY-OWNTWK3	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE	IOLAN STS16DC	No	2	27733									12.00	10.00						
					H063-SSS-NBAY-OWNTWK3	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE	IOLAN STS16DC	No	2	27733									12.00	10.00						
					H063-SSS-NBAY-OWNTWK3	[redacted]			Yes	6	27632									12.00	10.00						
					H063-SSS-NBAY-OWNTWK3				Yes	6	27632									12.00	10.00						
					H063-SSS-NBAY-TIMING3	GPS CLOCK TEKRON TCG01-D:07	TEKRON	TCG01	Yes	3	27092					12.06	6.03										
SCADA & OpsWAN	Building +4 (275kV) - Station SCADA (NSCs, LCF), Aux Control, Timing, OpsWAN & Common RTU	+4B1	2007	3.71	H063-SSS-NBAY-LCF4	LOCAL CONTROL FACILITY SUN ULTRA 25	SUN	SUN ULTRA 25	Yes	8	29069					7.45	6.21					3.71	3.71	2045-2049	2027/28 (b)	2045-2049	2045-2049
					H063-SSS-NBAY-LCF4	MONITOR TFT	SUN	X7202A	Yes	0	27054					2.61	1.31										
					H063-SSS-NBAY-OWINVRT4	INVERTER 125VDC/240VAC 1500W	LATRONICS	IRM15120	No	2	25941									12.19	6.10						
					H063-SSS-NBAY-OWNTWK4	SWITCH 8PORT	RUGGEDCOM	RS8000A-HI-MM-MS	Yes	7	27400									12.00	10.00						
					H063-SSS-NBAY-OWNTWK4	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE	IOLAN STS16DC	No	2	27733									12.00	10.00						
					H063-SSS-NBAY-OWNTWK4	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	PERLE	IOLAN STS16DC	No	2	27733									12.00	10.00						
					H063-SSS-NBAY-OWNTWK4	[redacted]			Yes	6	27632									12.00	10.00						
					H063-SSS-NBAY-OWNTWK4				Yes	6	27632									12.00	10.00						
					H063-SSS-NBAY-TIMING4	GPS CLOCK TEKRON TCG01-D:07	TEKRON	TCG01	Yes	3	27092					12.19	6.10										
OpsWAN Cameras	OpsWAN Outdoor Cameras		2010	2.86	H063-SSS-NBAY-OWCAM1	CANON ETHERNET CAMERA	CANON	VB-C10R	Yes	0	27074									12.00	10.00						
					H063-SSS-NBAY-OWCAM2	AXIS ETHERNET CAMERA ASSEMBLY	Take a Look	P5532-E	No	10	33869									5.51	4.59						
					H063-SSS-NBAY-OWCAM3	CANON ETHERNET CAMERA	CANON	VB-C10R	Yes	0	27074									12.00	10.00						
					H063-SSS-NBAY-OWCAM3	AXIS ETHERNET CAMERA ASSEMBLY	Take a Look	P5532E	No	10	33869									8.03	6.69						
BLDG +3 DC AUXILIARY SUPPLY	BUILDING +3 125V DC X BATTERY		2007	10.00		BUILDING +3 125V DC X BATTERY	CENTURY YUASA	UXL220																	2019		
	BUILDING +3 125V DC X BATTERY MONITOR AND CHARGER	+3AC1	2007	6.50		BUILDING +3 125V DC X BATTERY MONITOR AND CHARGER	CORDEX	ARGUS CXRC																	2027		
	BUILDING +3 125V DC Y BATTERY		2007	10.00		BUILDING +3 125V DC Y BATTERY	CENTURY YUASA	UXL220																	2019		
	BUILDING +3 125V DC Y BATTERY MONITOR AND CHARGER	+3C1	2007	6.50		BUILDING +3 125V DC Y BATTERY MONITOR AND CHARGER	CORDEX	ARGUS CXRC																	2027		
	BUILDING +3 125V DC DISTRIBUTION BOARD		2007	6.50		BUILDING +3 125V DC DISTRIBUTION BOARD																			2027		
BLDG +4 DC AUXILIARY SUPPLY	BUILDING +4 125V DC X BATTERY		2007	10.00		BUILDING +4 125V DC X BATTERY	CENTURY YUASA	UXL220																	2019		
	BUILDING +4 125V DC X BATTERY MONITOR AND CHARGER	+4C1	2007	6.50		BUILDING +4 125V DC X BATTERY MONITOR AND CHARGER	CORDEX	ARGUS CXRC																	2027		
	BUILDING +4 125V DC Y BATTERY		2007	10.00		BUILDING +4 125V DC Y BATTERY	CENTURY YUASA	UXL220																	2019		
	BUILDING +4 125V DC Y BATTERY MONITOR AND CHARGER	+4C1	2007	6.50		BUILDING +4 125V DC Y BATTERY MONITOR AND CHARGER	CORDEX	ARGUS CXRC																	2027		
	BUILDING +4 125V DC DISTRIBUTION BOARD		2007	6.50		BUILDING +4 125V DC DISTRIBUTION BOARD																			2027		

Planning Statement	30 June 2020
Title	CP.02817 – H063 Teebar Creek Secondary Systems Replacement – Planning Statement [1]
Zone	Wide Bay
Need Driver	Emerging compliance risks arising from condition and obsolescence of Teebar Creek's ageing secondary systems.
Network Limitation	Teebar Creek 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 Teebar Creek Substation are increasingly at risk of failing to comply with Schedule 5.1.9(c) of the National Electricity Rules and AEMO's Power System Security Guidelines[2].

Energy Queensland forecasts confirm there is an enduring need to maintain electricity supply into the Wide Bay area. The removal or reconfiguration of the Teebar Creek Substation due to secondary system failure/obsolescence would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard.

The preferred network solution for Powerlink to continue to meet its statutory obligations is to maintain the current function and capacity by the replacement of all at-risk secondary systems by December 2028.

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

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

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

Table of Contents

1. Introduction

The Teebar Creek Substation was established in 2007 and is located 50 kilometres west of Maryborough. Teebar Creek Substation is connected to the 275kV network between Central and South Queensland and is an essential bulk supply point for load and renewable generation connection in the Wide Bay area.

A condition assessment of the 275kV and 132kV secondary systems at H063 Teebar Creek Substation has determined they are approaching the end of their technical life and recommends that they be replaced by the end of 2028.

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

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

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

2. Teebar Creek Demand Forecast

The substation is comprised of two switchyards;

1. The 275kV switchyard, which has two feeders connecting to Gin Gin and Woolooga substations respectively, and

2. The 132kV switchyard, which provides 2 X 132 kV connections to Energy Queensland's network.

Figure 1 shows connection of Teebar Creek Substation to Gin Gin and Woolooga substations, by 275kV transmission circuits, as well as its connection to the Energy Queensland network in the Wide Bay area via two 275/132kV transformers.

[redacted]

Figure 1 - Teebar Creek Substation Single Line Diagram

Teebar Creek Substation delivers power to the Wide Bay region, including the loads of Maryborough and Isis. Additionally, large-scale solar farms of Susan River and Childers are connected to Maryborough and Isis substations respectively. The solar farms have a combined capacity of 131MW. Munna Creek and Aramara solar farms are also committed to connect to Ergon's Kilkivan and Aramara substations in summer 2022/23 and 2021/22 respectively. The Munna Creek Solar Farm has a capacity of 120MW. The Aramara Solar Farm has a capacity of 104MW.

To manage a transformer outage at Teebar Creek Substation, connections to both Bundaberg and Kilkivan are opened. Consequently, only Maryborough and Isis will remain connected to Teebar Creek. The loss of Teebar Creek 275kV injection would result in the loss of all loads and generators that remain connected to the substation.

Figure 2 shows the historical load duration curve for Teebar Creek Substation. In 2019, the energy delivered was less than historical trends. This was due to the embedded solar farms. However, the peak load remained at a similar level to previous years (coinciding with late afternoon/evening peak load).

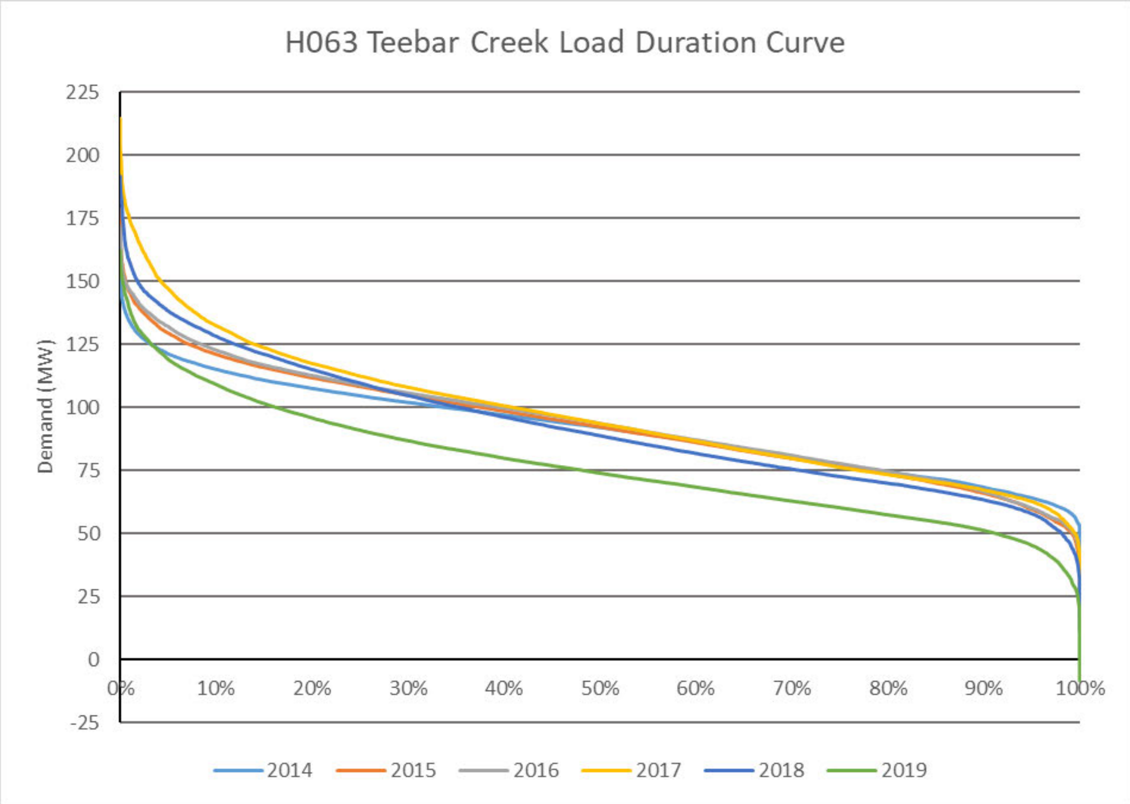


Figure 2 - Teebar Creek Load Duration Curve

Figure 3 shows the forecast summer maximum demand is not expected to change materially in coming years. The summer 10% PoE maximum demand is forecast to increase to just under 200MW by 2029/30.

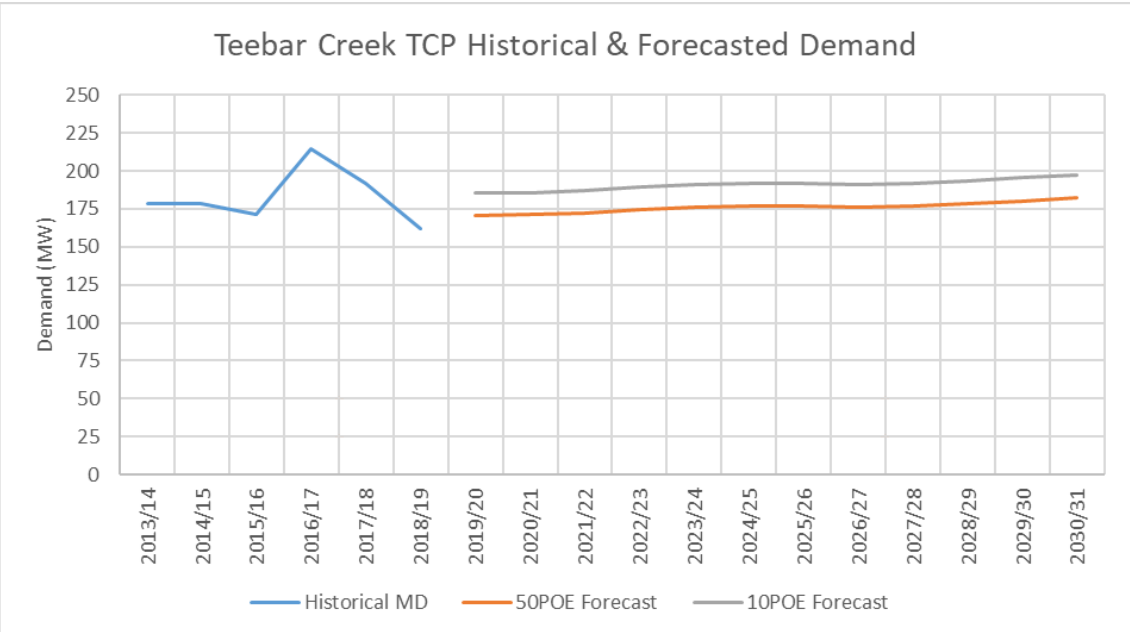


Figure 3 - Teebar Creek TCP Maximum Demand

3. Statement of Investment Need

As outlined in Section 2, the Teebar Creek Substation forms part of the transmission network between Central and South Queensland as well as being an essential bulk supply point for load in the Wide Bay area.

The potential impact on the CQ-SQ power transfer capability could be mitigated by directly connecting the two 275kV circuits and bypassing the Teebar Creek Substation.

However, removing the 275/132kV functionality of this substation would have a significantly impact the reliability of supply to the Wide Bay area. Without the Teebar Creek injection to the 132kV network, the Gin Gin and Woolooga substations are not able to adequately support the Maryborough and Isis loads and Powerlink would exceed the N-1-50MW/600MWh reliability obligations.

Figure 4 shows the operating diagram for the Teebar Creek Substation.

[redacted]

Figure 4 Teebar Creek 275/132kV Operating Diagram

The secondary systems are required to operate Teebar Creek Substation. Therefore, the secondary systems at Teebar Creek Substation is required to avoid system failures that would result in loss of load in excess of Powerlink's N-1-50MW / 600MWh reliability standard.

4. Load at Risk

The table below presents the load at risk as well as the energy at risk at Teebar Creek Substation. The average load supplied from Teebar Creek Substation is 91MW in 2020. In the event of a total outage at the substation, the N-1-50MW/600MWh reliability standard would be breached. The energy lost as a result of an outage would, on average, exceed 600MWh in under seven hours.

Table 1 - Teebar Creek Load at Risk

Load at Risk	Contingency	Metric	2020	2030
Maryborough and Isis	132kV Feeders 7315 and 7316	Max (MW)	212	218
		Average (MW)	91	92
		24h Energy Unserved Max (MWh)	3520	3593
		24h Energy Unserved Average (MWh)	2183	2201

5. Non Network Options

The Teebar Creek Substation facilitates 275kV flow between Central and Southern Queensland. The substation also hosts two 275/132kV transformers to facilitate supply to Ergon loads between Woolooga and Gin Gin substations.

To meet the Teebar Creek demand, the non-network solutions would need to provide supply to the 66kV Maryborough and Isis networks. To meet the demand of the combined Maryborough and Isis network, the non-network solution must be capable to delivering up to 220MW of power and 3600MWh of energy each day. The non-network solution would be required to be capable of operating during a contingency or outage on a continuous basis until normal supply is restored.

Powerlink is not aware of any Demand Side Solutions (DSM) in the area supplied by Teebar Creek 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 275/132kV secondary systems at H063 Teebar Creek Substation before the end of 2028. This option ensures that all reliability of supply and asset condition criteria are met, as well as maintaining the power transfer capability between Central and South Queensland.

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

6.2 Option Considered but Not Proposed

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

6.2.1 Do Nothing

“Do Nothing” would not be an acceptable option as the primary drivers (secondary system 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.

6.2.2 Supply from Gin Gin and Wolooga substations

Reinforcing the 132kV network from Gin Gin > Bundaberg > Isis > Kilkivan > Woolooga to support the load was not considered economically feasible. Thermal limits would be exceeded and voltages would fall below acceptable levels. Furthermore, the low marginal cost renewable generation in the area would likely be impacted with a material reduction is system strength due to the lack of fault level that the Teebar Creek Substation provides.

7. Recommendations

Powerlink has reviewed the condition of the secondary systems at Teebar Creek Substation and anticipates they will reach end of technical service life by the end of 2028. It is therefore recommended that the systems be replaced by December 2028.

Retaining Teebar Creek Substation will allow Powerlink to continue to meet its required reliability obligations (N-1-50MW/600MWh) and maintain power transfer capability between central and South Queensland.

Powerlink is currently unaware of any feasible alternative options to minimise or eliminate the load at risk at Teebar Creek 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. H063 Teebar Creek Secondary Systems Condition Assessment Report
2. Project Scope Report CP.02817 Teebar Creek Secondary Systems Replacement Concept
3. Transmission Annual Planning Report 2020
4. Asset Planning Criteria Framework

Base Case Risk Cost Summary Report

CP.02817 Teebar Creek Secondary Systems Replacement

Version Number	Objective ID	Date	Description
1.0	A3395074	09/07/2020	Original document.

1 Purpose

The purpose of this model is to quantify the base case risk cost profiles for the secondary systems at Teebar Creek substation which is proposed for reinvestment under CP.02817. 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 Teebar Creek 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. 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 Wide Bay and Burnett area;
- The most recent load and energy forecasts for the Wide Bay and Burnett area have been used when assessing the projected network consequences;
- Teebar Creek substation supplies a mixture of residential, commercial and agricultural loads. Historical load data and estimates have been used to analyse the proportion of these load types, and a weighted average VCR of $30,583/MWh has been used when evaluating network risk cost;
- VCRs for residential, agricultural and industry load types 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.

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. Network and financial risks are considered material and are modelled in this analysis.

3.2 Secondary Systems Analysis

This section analyses the risks presented by the relevant secondary systems at Teebar Creek 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 within Figures 2 to 4 below.

There is a significant relative increase in risk cost from 2028 onwards, which can be attributed to obsolescence of equipment within a number of substation bays being reached at the same time. This leads to both higher financial and network risk cost.

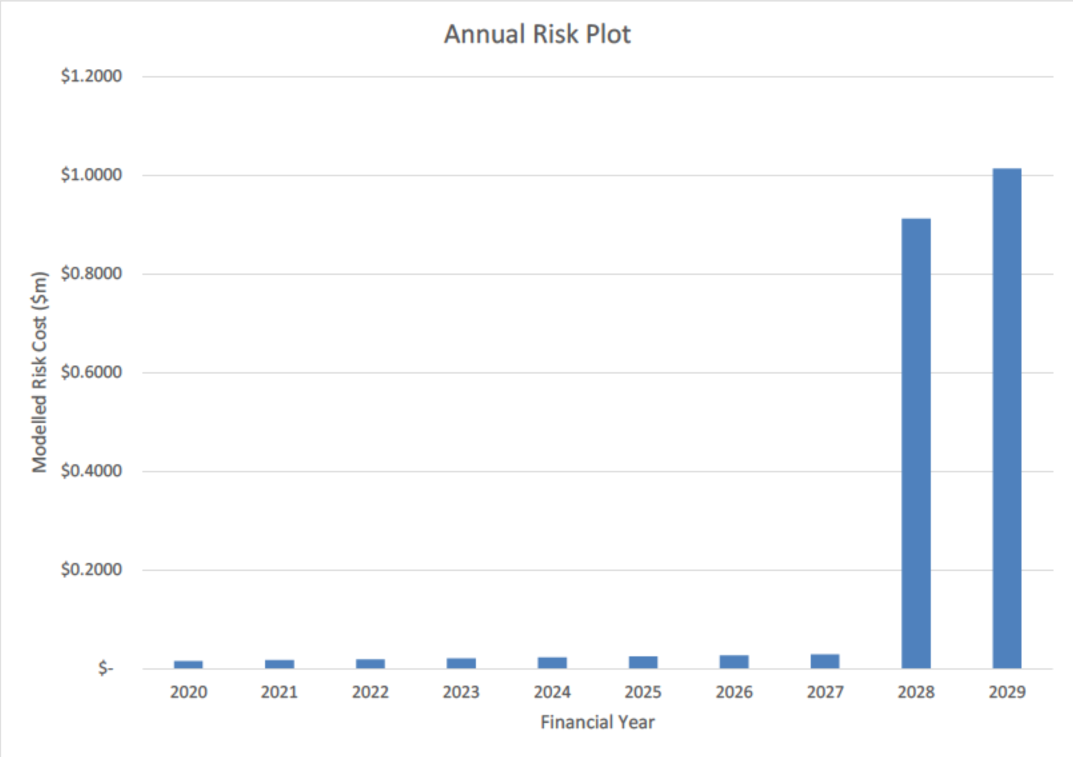


Figure 1 – Teebar Creek secondary systems total risk cost

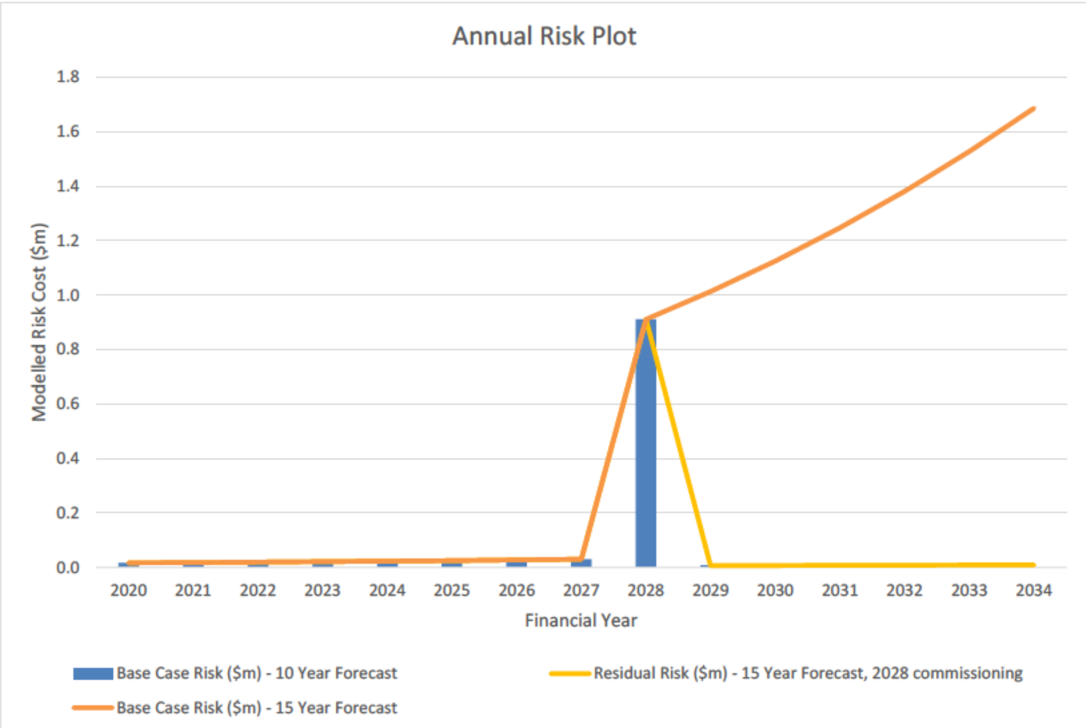


Figure 2 – Teebar Creek secondary systems risk cost (10 and 15 years)

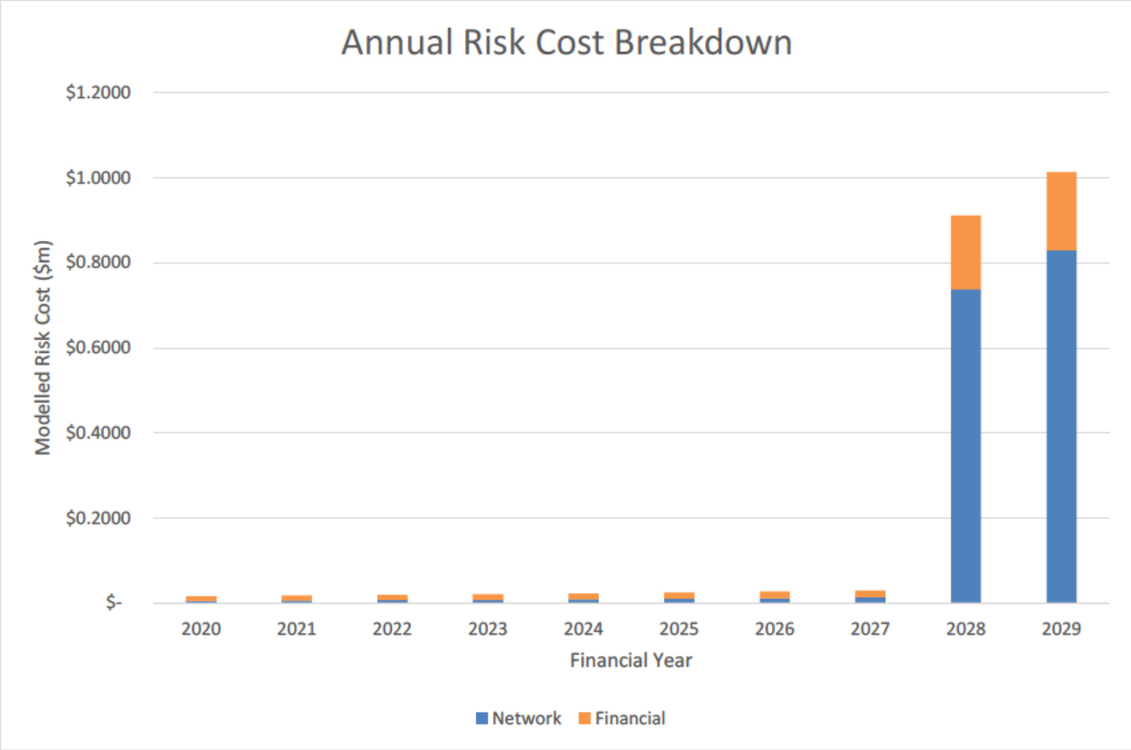


Figure 3 – Teebar Creek secondary systems risk cost by category

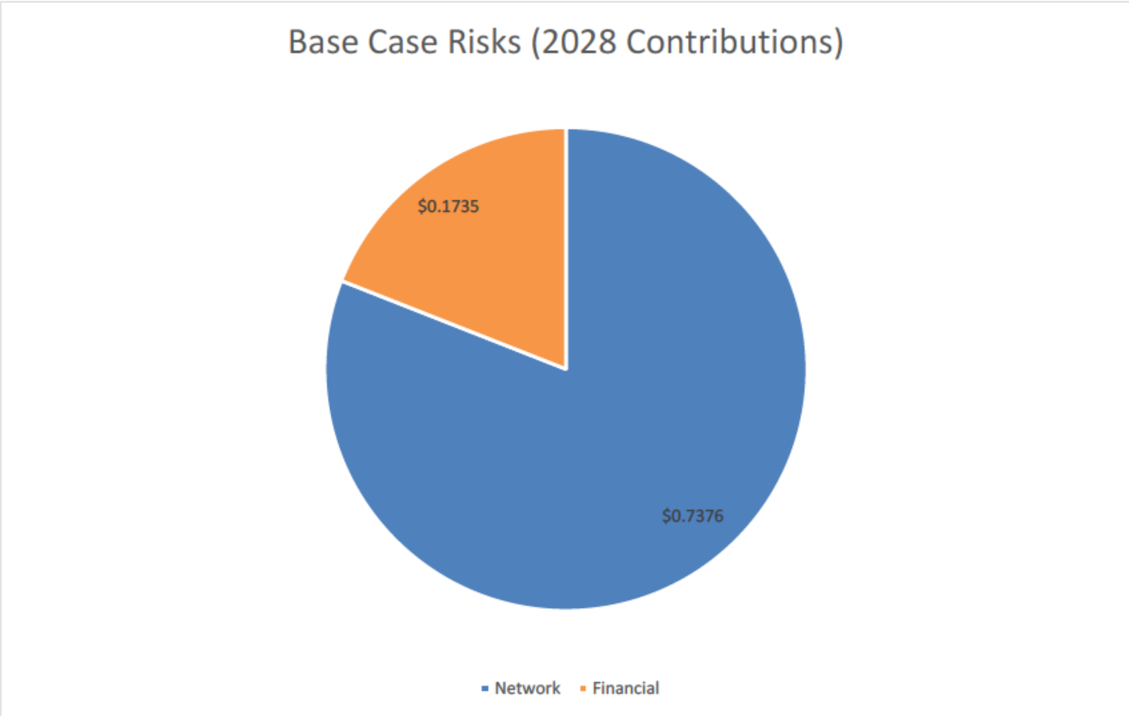


Figure 4 – Teebar Creek 2028 risk cost by category

3.4 Base case risk statement

The main base case risks for the secondary systems at Teebar Creek 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 81%. Hence, an increase in VCR of 100% would increase the overall risk cost by around 81%.

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

Table 2: Input values, secondary systems model

	Item	Value	Unit
Network	VCR	30,583	$/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

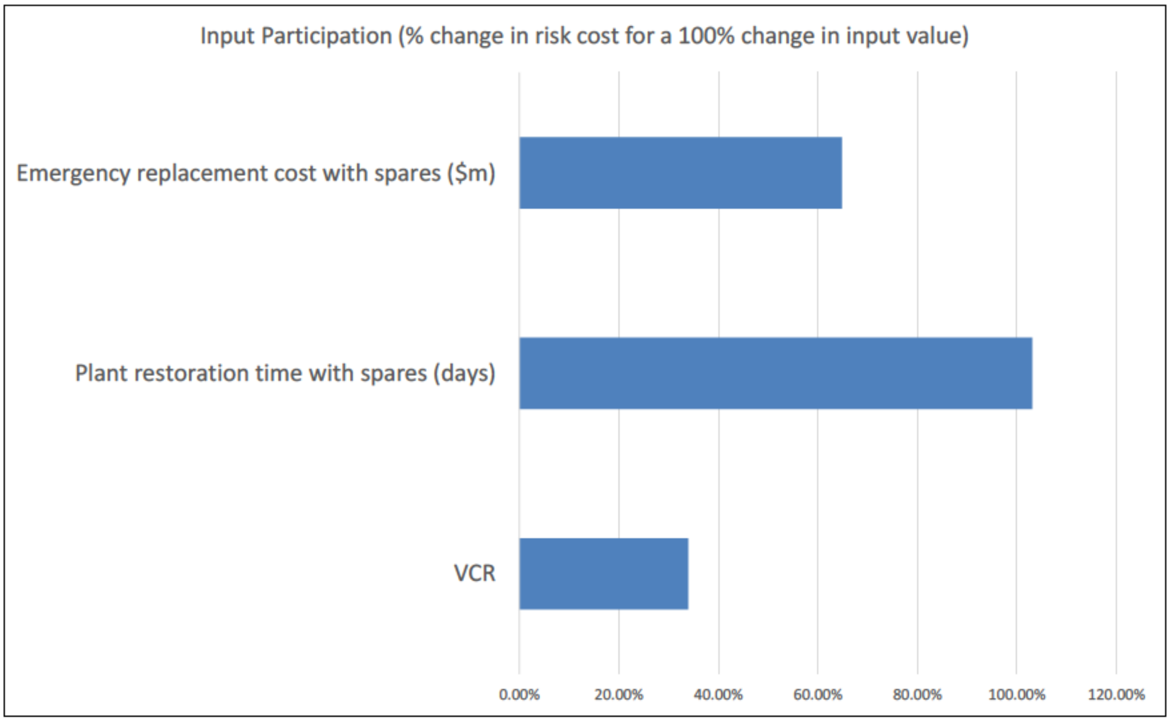


Figure 5 - Participation factors, secondary systems model – pre secondary systems obsolescence

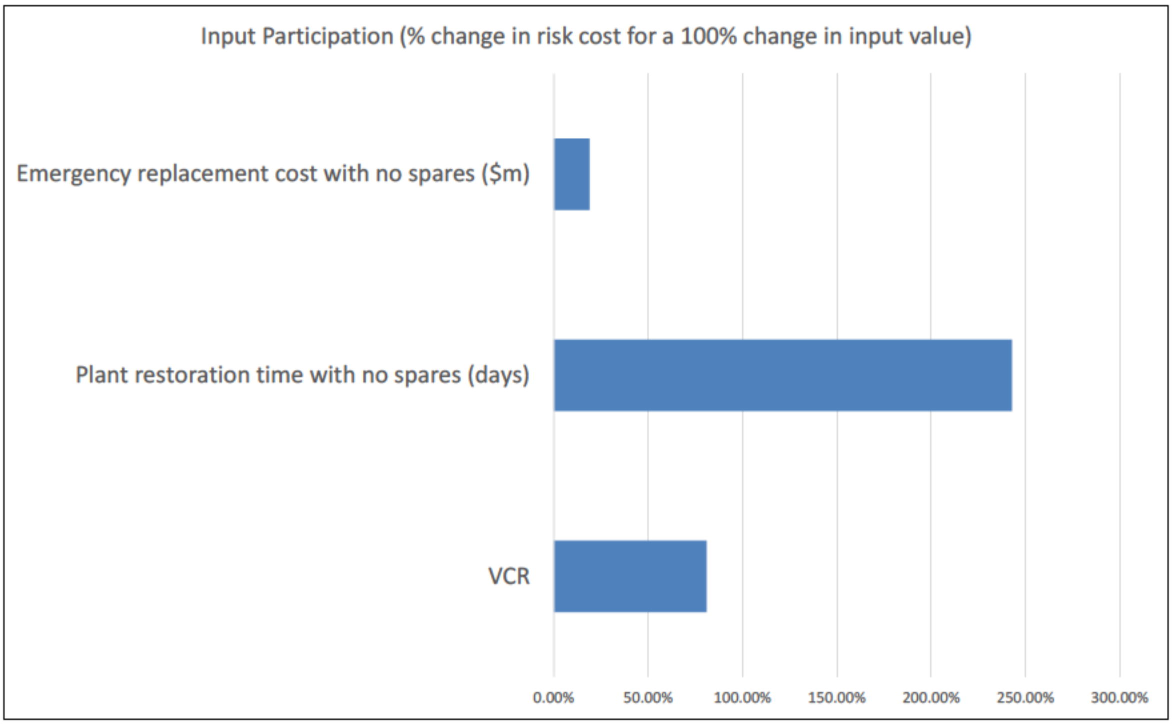


Figure 6 - Participation factors, secondary systems model – post secondary systems obsolescence

Project Scope Report

CP.02817

Teebar Creek Secondary Systems Replacement

Concept – Version 1

Document Control

Change Record

Issue Date	Responsible Person	Objective Document Name	Background
5/6/20	[redacted]	Project Scope Report CP.02817 Teebar Creek Secondary Systems Replacement Concept	Preliminary scope

Related Documents

Issue Date	Responsible Person	Objective Document Name
27/02/2020	[redacted]	H063 Teebar Creek Secondary Systems Condition Assessment Report - 18 May 2020 (A3363054)

Project Contacts

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

Project Details

1. Project Need & Objective

Teebar Creek Substation is located approximately 260km North-West of the Brisbane CBD. Established in 2007, it is a 275/132kV bulk supply point, providing 132kV injection into the southern section of the Wide Bay area.

A recent condition assessment indicates that the secondary systems is reaching the end of its technical asset life and recommends replacement of the equipment by 2028.

The objective of this project is to replace the secondary systems at Teebar Creek Substation by 31 December 2027.

2. Project Drawing

[redacted]

Figure 1 – Operational diagram for H063 Teebar Creek

Figure 2 – H063 Teebar Creek – Aerial View looking North

3. Project Scope

3.1. Original Scope

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

Briefly, this project consists of replacement of the existing 275kV and 132kV Secondary System panels Teebar Creek Substation within the existing buildings.

3.1.1. Transmission Line Works

Not Applicable

3.1.2. H063 Substation Works

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

- Establish new 275kV and 132kV secondary systems panels and associated common control, protection and monitoring equipment in the existing buildings.
- Effect the staged cutover, testing and commissioning of the existing secondary systems panels and associated equipment to the new control system, in accordance with current Powerlink design standards, including;

  <u>Existing Building +4: -</u>

  - 275kV 1 BUS ZONE X & Y PROTECTION
  - 275kV 2 BUS ZONE X & Y PROTECTION
  - 275kV FEEDER 826
  - 275kV COUPLER 5022
  - 275kV TFMR 1
  - 275kV COUPLER 5032
  - 275kV TFMR 2
  - 275kV COUPLER 5052
  - 275kV FEEDER 8850
  - 125V DC X & Y DB & Battery Charger;
  - NSC/LCF/Common RTU, OPSWAN and associated equipment; and
  - GPS clock

  <u>Existing Building 3: -</u>

  - 132kV 1 BUS ZONE X & Y PROTECTION
  - 132kV 2 BUS ZONE X & Y PROTECTION
  - 132kV COUPLER 4122
  - 132kV TFMR 1 LV
  - 132kV FEEDER 7315

- 132kV FEEDER 7316
- 132kV TFMR 2 LV
- 125V DC X & Y DB & Battery Charger;
- Metering equipment and panel based on current standard;
- NSC1, NSC2 and LCF RTU and associated panel. Upgrade SCADA to DNP/IP;
- NSC/LCF/Common RTU, OPSWAN and associated panel;
- GPS clock; and
- Install new Power Quality Monitoring panel.

Existing Building +2: -

- LCF
- Master OpsWAN and terminal server
- Replace dual 48VDC charger and batteries

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

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

- Establish new cable termination racks such that cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination rack without need to re-run cables to the yard marshalling kiosks.
- Construct cable trenches to the new cable termination racks and run cables from the new cable termination rack to the new control buildings as appropriate;
- All fibre termination panels shall be located in one of the new buildings as appropriate
- Fire panels, fire protection equipment as well as substation security related equipment shall be located in one of the new buildings or Amenities building as appropriate.
- Decommission and remove the old control buildings +3 & +4.

3.1.3. Remote End Substation Works

Modify remote end protection, control, automation and communications systems as required at H005 Woolooga, H006 Gin Gin and T173 Aramara.

3.1.4. Telecoms Works

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

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

In the event new control buildings are required then:

- The location of new control buildings shall consider minimizing cable requirements and modification;
- The location of the new cable termination rack shall consider future replacement 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.

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 H063 Teebar Creek 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 2027

5. Special Considerations

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

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

- a high level project implementation plan including staging and outage plans should be considered as part of the estimate

6. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

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

The Business Development team will provide the primary customer interface with Energy Queensland. 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 Energy Queensland will be the landing spans of Feeder 7315 & 7316.

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 Energy Queensland. 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

Not applicable.

Concept Estimate for CP.02817 Teebar Creek Secondary Systems Replacement

Record ID	A3374409	
Policy stream	Asset Management	
Authored by	Project Manager	[redacted]
Reviewed by	Senior Project Manager	[redacted]
Reviewed by	Projects Team leader	[redacted]
Approved by	Manager Projects	[redacted]

Table of Contents

1. Executive Summary

Teebar Creek Substation is located approximately 260km North-West of the Brisbane CBD. Established in 2007, it is a 275/132kV bulk supply point, providing 132kV injection into the southern section of the Wide Bay area. A recent condition assessment indicates that the secondary systems is reaching the end of its technical asset life and recommends replacement of the equipment by 2028.

The objective of this projects is to replace the secondary systems at Teebar Creek Substation by December 2027.

Figure 1-1: Teebar Creek Substation Aerial View

[redacted]

Figure 1-2: Teebar Creek Substation Line Diagram

1.1 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / -50%		
Base Estimate		**18,622,342**	**23,019,769**
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 2025	5,217,030	6,103,155
To June 2026	5,489,898	6,711,474
To June 2027	5,391,465	6,861,375
To June 2028	2,523,949	3,343,765
TOTAL	**18,622,342**	**23,019,769**

2. Project and Site Specific Information

2.1 Project Dependencies & Interactions

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

Project No.	Project Description	Planned Commissioning Date	Comment
Dependencies			
Interactions			
OR.02818	Woolooga Selected Primary Plant Replacement		
Other Related Projects			
CP.02392	Woolooga 275/132kV Substation Secondary Systems Replacement		

2.2 Site Specific Issues

Utilizing the existing cables may result in creating some challenges depending on the volume of cables and the fact that some cables might have been buried under a large number of other cables.

3. Teebar Creek Secondary System Replacement

3.1 Definition

3.1.1 Scope

This project consists of replacement of the existing 275kV and 132kV Secondary System panels Teebar Creek Substation.

3.1.1.1 Substations Works

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

- Establish new 275kV and 132kV secondary systems panels and associated common control, protection and monitoring equipment in the existing buildings.
- Effect the staged cutover, testing and commissioning of the existing secondary systems panels and associated equipment to the new control system, in accordance with current Powerlink design standards, including;

Existing Building +4: -

- 275kV 1 Bus Zone X & Y Protection
- 275kV 2 Bus Zone X & Y Protection
- 275kV Feeder 826
- 275kV Coupler 5022

- 275kV TFMR 1
- 275kV Coupler 5032
- 275kV TFMR 2
- 275kV Coupler 5052
- 275kV Feeder 8850
- 125V DC X & Y DB & Battery Charger;
- NSC/LCF/Common RTU, OPSWAN and associated equipment; and
- GPS clock

Existing Building 3: -

- 132kV 1 Bus Zone X & Y Protection
- 132kV 2 Bus Zone X & Y Protection
- 132kV Coupler 4122
- 132kV TFMR 1 LV
- 132kV Feeder 7315
- 132kV Feeder 7316
- 132kV TFMR 2 LV
- 125V DC X & Y DB & Battery Charger;
- Metering equipment and panel based on current standard;
- NSC1, NSC2 and LCF RTU and associated panel. Upgrade SCADA to DNP/IP;
- NSC/LCF/Common RTU, OPSWAN and associated panel;
- GPS clock; and
- Install new Power Quality Monitoring panel.

Existing Building +2: -

- LCF
- Master OpsWAN and terminal server
- Replace dual 48VDC charger and batteries
- Decommission and recover all redundant equipment, and update drawing records, SAP records, configure files, etc. accordingly.

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

- Establish new cable termination racks such that cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination rack without need to re-run cables to the yard marshalling kiosks.
- Construct cable trenches to the new cable termination racks and run cables from the new cable termination rack to the new control buildings as appropriate;
- All fibre termination panels shall be located in one of the new buildings as appropriate
- Fire panels, fire protection equipment as well as substation security related equipment shall be located in one of the new buildings or Amenities building as appropriate.
- Decommission and remove the old control buildings +3 & +4.

3.1.1.2 Transmission Line Works

Not applicable.

3.1.1.3 Telecommunication Works

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

3.1.1.4 Easement/Land Acquisition & Permit Works

Not applicable.

3.1.2 Major Scope Assumptions

The following key assumptions were made for this Project Estimate:

- It has been assumed that two new demountable buildings will be required to facilitate the staging whilst minimising outage requirements – this will be reviewed at proposal stage;
- Construct and commission two new cable termination rack such that cables terminated directly between the existing secondary systems panels and marshalling kiosks can be relocated from the existing control buildings to new cable termination rack without need to re-run cables to the yard marshalling kiosks;
- Anticipated date for approval is Jan 2024. The commissioning date of December 2027 is based on a high level staging plan over 2 years from July 2025 to October 2027 with demolition completed by December 2027;
- It is assumed that no Restricted Access Zone will be deployed on this site during construction.
- New building foundations will include the provision of bored piers and the estimates include the sufficient costs for geo-tech;
- It is assumed that the new Telecommunication equipment will be accommodated in the existing communications building;
- FAT is planned to be conducted at Virginia;
- New 275kV building is assumed to be installed back to back with the existing building. New termination rack to be installed next to the existing building as shown in below photo;

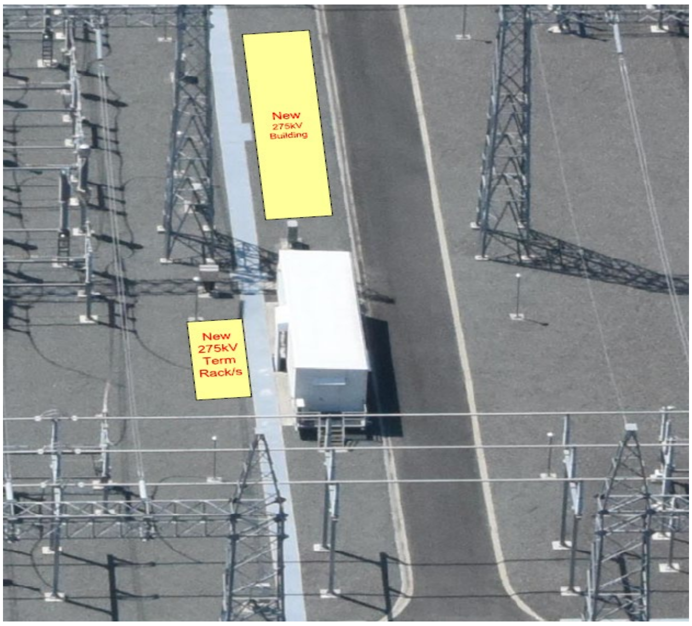


Figure 3-1: Location of new 275kV building and new termination rack

- New 132kV building is assumed to be installed close to the exiting building as per below sketch;

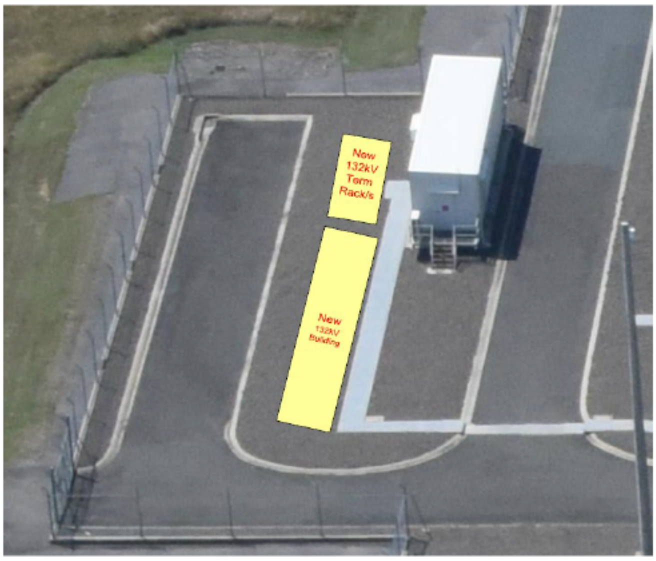


Figure 3-2: Location of new 132kV building and new termination rack

3.1.3 Scope Exclusions

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

3.2 Project Execution

3.2.1 Project Schedule

A High Level Project Schedule is as follow:

Milestone	Date
Project Approval	January 2024
Contract Award	January 2025
Design Commencement	February 2025
Design Complete	June 2025
Site Access Date	April 2025
Civil and Construction	April 2025 to October 2025
FAT	September 2025 – February 2026
Staged Commissioning	April 2026 - October 2027 (In non-wet seasons over two years)
Final Decommissioning	December 2027
Project Completion	December 2027

3.2.2 Network Impacts

Based on the initial negotiation with the Network Outage Coordinators, it is assumed that the outages as proposed will be available in non-wet seasons and no Live Sub/Live lines are required.

3.2.3 Project Staging

Stage	Description/Tasks
1	275kV 1 Bus and 2 Bus, inc VTs
2	Diameter =C05
3	132kV 1-3 Bus, inc VTs
4	Diameter =C03 and T2 onto 1 Bus
5	Diameter =C02
6	Coupler 5022
7	Diameter D04 and T1 onto 2 Bus.
8	Coupler 4112
9	D07 - Feeder 7316 Aramara (Ergon)
10	D08 - Feeder 7315 Aramara (Ergon)
11	275KV 1 Bus and 2 Bus (Segregate old from new)
12	132KV 1-3 Bus (Segregate old from new)
13	Final decommissioning and removal of +3 and +4 building panels.
14	Project Post Commissioning and Drawing Management

3.2.4 Resourcing

- Assumption is that the project will be Design and Construct.
- MSP resources will carry out the FAT, SAT and commissioning.
- Decommissioning works.

3.3 Project Estimate

Estimate Components		Base $	Escalated $
Estimate Class	5		
Estimate Accuracy	+100% / -50%		
Base Estimate		**18,622,342**	**23,019,769**
Mitigated Risk	[redacted]	[redacted]	[redacted]
Contingency Allowance	[redacted]	[redacted]	[redacted]
TOTAL		[redacted]	[redacted]

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To June 2027	5,391,465	6,861,375
To June 2028	2,523,949	3,343,765
TOTAL	**18,622,342**	**23,019,769**

3.5 Project Asset Classification

Asset Class	Asset Life	Base $	Percentage
Secondary systems	15 years	14,475,426	78%
Communications	15 years	800,648	4%
Transmission line refit	35 Years		
Primary plant	40 years	3,346,268	18%
Transmission lines	50 years		
TOTAL		**18,622,342**	

4. References

Document name	Version	Date
Project Scope Report	1.0	05/06/2020