January 2026

# Powerlink 2027-32 Revenue Proposal

## Project Pack

## CP.02800 Alligator Creek Substation Reinvestment

*Project Status: Unapproved*

## Network Requirement

The Alligator Creek Substation was established in the early 1980s. It is a 132/33kV bulk supply point for the southern Mackay region providing supply to the Aurizon Oonooie and Mackay Ports connections, the Hay Point and Dalrymple Bay coal loading terminals and surrounding communities via the Ergon network. The substation was subsequently expanded and reconfigured in the mid-2000's.

Some of the primary plant dates from the original substation establishment and is now over 40 years old. Selected circuit breakers are now operating with reduced reliability due to age related condition issues, including recurring SF6 leaks. Instrument transformers are porcelain-housing type, and based on available statistical data have increased probability of catastrophic failure presenting high safety risk. A number of disconnectors and earth switches have high contact resistance and corrosion of various parts requiring increased maintenance. There are also electrical clearance issues in bay D05, necessitating replacement of the transformer circuit breaker and the current transformers with a Dead Tank Circuit Breaker [1].

A condition assessment indicates that most secondary systems devices are reaching the end of their technical asset life, recommending replacement by 2025. It further notes that the field cables are suitable for a further 15 to 20 years of service and that the secondary systems panels are in good condition and may be retained [2]. The driver for replacing secondary systems is the obsolescence and end of manufacturer support for the existing relays. Ageing secondary systems, which are no longer supported by the manufacturer, and primary plant showing signs of deterioration at Alligator Creek Substation are increasingly at risk of failing to comply with Schedule 5.1.9(c) of the National Electricity Rules, AEMO's Power System Security Guidelines and the reliability standard included in Powerlink's Transmission Authority.

Powerlink's 2025 Central scenario forecast confirms there is an enduring need to maintain electricity supply into the southern Mackay area. The removal or reconfiguration of the Alligator Creek 132/33kV Substation due to secondary system or primary plant failure or obsolescence would violate Powerlink's N-1-50MW/600MWh Transmission Authority reliability standard [3].

## Recommended Option

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

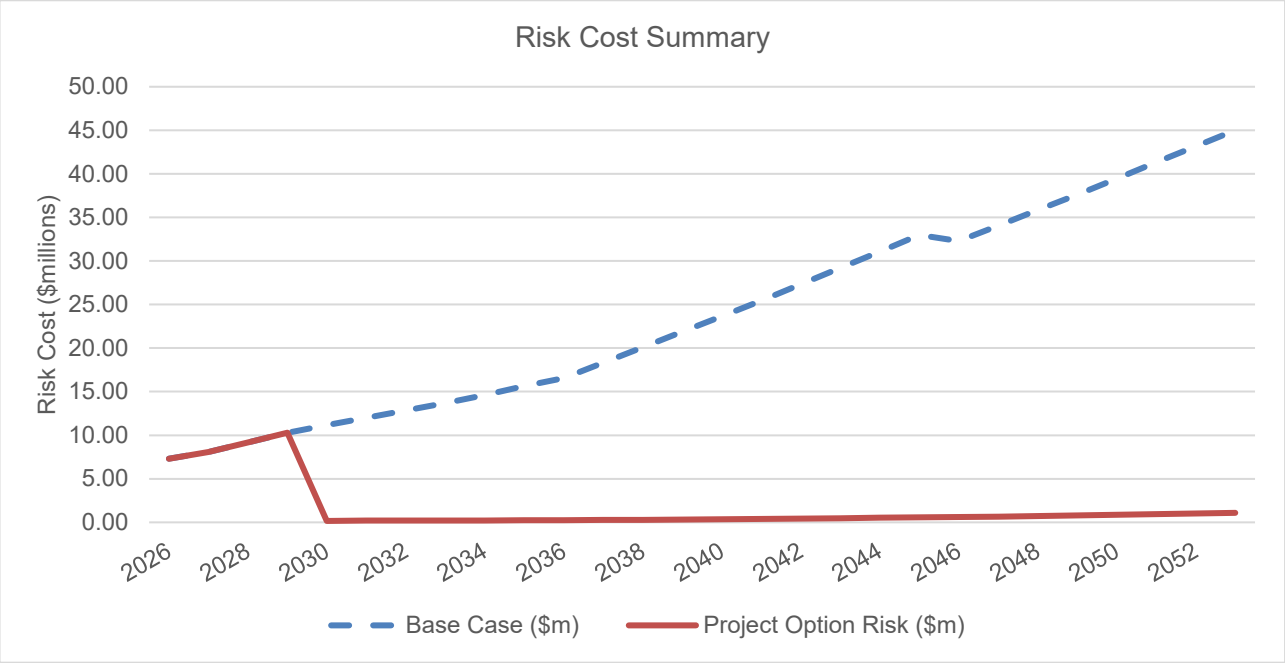
The current recommended option is for in-situ replacement of all secondary systems in the existing control building by 2028 together with replacement of selected primary plant [4].

Options considered but not proposed include:

- Replacement of all secondary systems in a new demountable building – expected to be greater overall cost.

Figure 1 shows the current recommended option reduces the forecast risk monetisation profile of the Alligator Creek Substation primary and secondary systems from around $10.3 million per annum in 2029 to less than $0.2 million from 2030 [6].

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




## Cost and Timing

The estimated cost to replace selected primary plant and all secondary systems at Alligator Creek Substation is $26.3 million ($2025/26) [5].

Target Commissioning Date: October 2028.

## Documents in CP.02800 Project Pack

### Public Documents

1. T065 Alligator Creek Condition Assessment Report
2. T065 Alligator Creek Secondary System Condition Assessment Report
3. CP.02800 Alligator Creek Substation Reinvestment – Planning Statement
4. CP.02800 Alligator Creek Substation Reinvestment – Project Scope Report
5. CP.02800 Alligator Creek Substation Reinvestment – Concept Estimate
6. CP.02800 Alligator Creek Substation Reinvestment – Risk Cost Summary Report

# Alligator Creek

# PRIMARY PLANT CONDITION ASSESSMENT REPORT

| | | | |
|---|---|---|---|
| **Report requested by:** | [redacted] | **Request Date:** | 23/05/2024 |
| **Report Prepared by:** | [redacted] | **Date of site visit:** | 18/06/2024 |
| **AUTHOR/S:** | [redacted] | | |
| **Report Approved by:** | [redacted] | **Report Approval Date:** | 10/04/2025 |
| **Report Reviewed by:** | [redacted] | **Review Date:** | 21/10/2024 |
| **Issue Approved by:** | | **Issue Date:** | |

| Date | Version | Objective ID | Nature of Change | Author | Authorisation |
|---|---|---|---|---|---|
| 16/09/2024 | 1 | A5631242 | - | [redacted] | |
| | | | | | |

***Note:*** *Where indicator symbol ☼# is used (# referring to version number) it indicates a change/addition was introduced to that specific point in the document. If the indicator symbol ☼# is used in a section heading it means the whole section was added/changed.*

**IMPORTANT**: - The condition assessment report provides an overview of the condition of all structures and equipment (excluding protection relays, control systems and telecommunication equipment)as stated in the scope and high level recommendations for their timely replacement. As it is snapshot in time and subject to the accuracy of prediction methodology, it is valid for 3 years form site visit date stated above.

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# EXECUTIVE SUMMARY

This report provides an overview of the condition of the high voltage equipment only in some limited parts of this site, the whole feeder bay T065-D06 7175 and CVTs inT065-D01-7319-7139 feeder bay. In addition, it explains compliance issues in T065-D05-442-4422. The condition and status of all other high voltage equipment is in satisfactory condition.

The report aims to identify asset condition and compliance triggers and forecasted risks associated with the current state of high voltage substation equipment, their supporting structures, and related infrastructure. Based on these findings, recommendations for refurbishment or replacement are provided.

The assessment has been formulated based on the data extracted from computerised maintenance management system (SAP) including:

- Notifications and work orders, dissolved gas analysis (DGA) and other test and measurement results;
- Equipment age information combined with available photos;
- Historical data analysis;
- Enhanced with the engineering understanding of the functions and engineering judgement of expected service life.

The summary of recommendations is contained in Table 3 presented in section 5 of this report.

# 1. INTRODUCTION

This condition assessment is based on a site visit conducted on 18/06/2024, available design data and drawings, updated SAP data (as of Jun 2024), and recommendations from the civil condition assessment report dated 16-07-2024 (A5579008).

## *1.1 System information*

T065 Alligator Creek substation was established in the early 1980s. It is a 132/33kV bulk supply point for the southern Mackay region providing supply to the Aurizon Oonooie and Mackay Ports connections, the Hay Point and Dalrymple Bay coal loading terminals and surrounding communities via the Ergon network.

T065 Substation consists of:

- 3 x 132kV buses;
- 6 x 132kV feeder bays;
- 2x132kV bus section bays;
- 1 x 132kV capacitor bay;
- 1 x 132kV static compensator bay;
- 2 x 132kV transformer bays;
- 2 x 132/33/11KV transformers;
- 1 x 132kV shunt capacitor;
- 2x33kV buses (owned by Ergon), and
- 1x33kV bus section bay (owned by Ergon).

Figure 1: Single Line Diagram

Figure 2- T065 Alligator Creek Substation Electrical Plant General Arrangement

Photo 1: Aerial Photograph of T065 Alligator Creek Substation

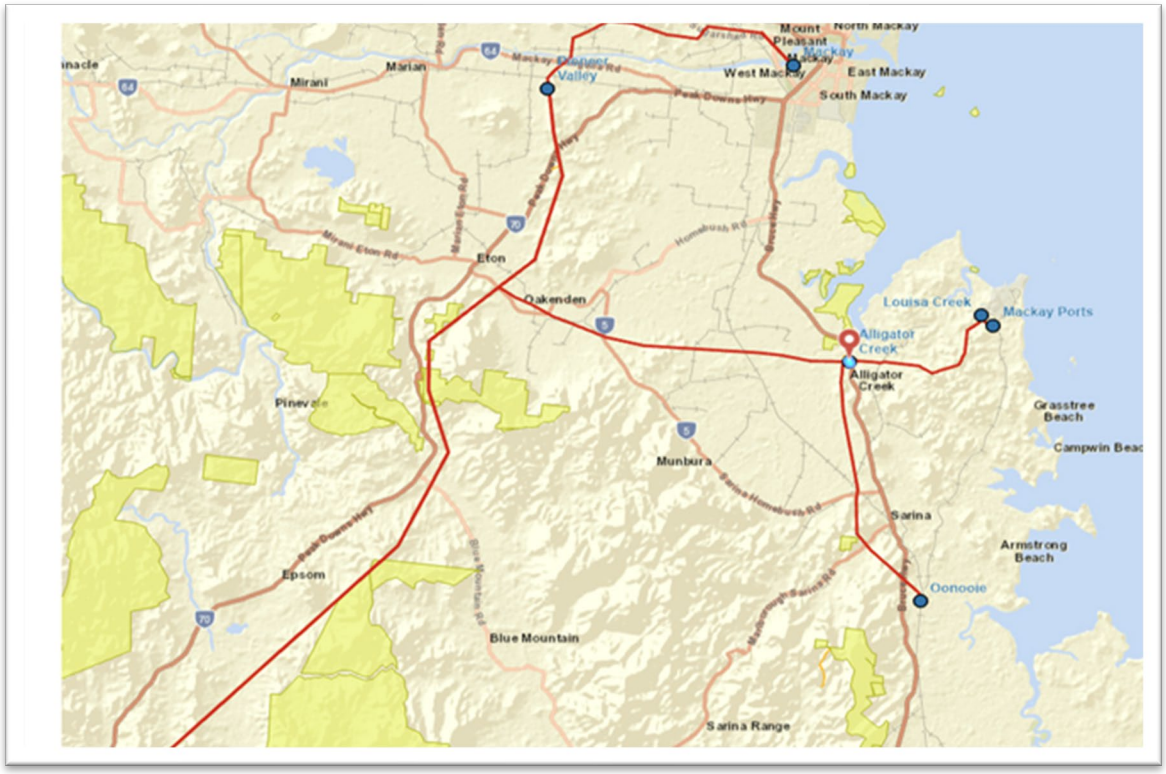



Figure 3: Overview of T065 Alligator Creek HV Supply Network

## 1.2 Ratings

The maximum fault levels calculated in June 2024 are:

- 132kV L-G – 5.9 kA
- 33kV L-G – 13.36 kA
- 26.2kV 3ph – 13.31 kA
- 11kV 3ph – 13.82 kA

Below table provides overview of continuous current and fault current ratings of all high voltage bays in Strathmore substation, incl. recommendations.

Table 1 – T065 Substation equipment ratings

| Functional Loc. | Description | Start-up date | Bay Continuous Rating | Bay Fault Current rating | Fault Current Period | Comments on Rating |
|---|---|---|---|---|---|---|
| T065-D01-7319 | 7319 FEEDER BAY 132kV | 14/09/2008 | 1,250 A | 25kA | 1s | Transmission line winter emergency rating is 800 A. |
| T065-D02-482- | 132kV 2 STATIC COMPENSATOR BAY | 01/07/2009 | 1000A | 25kA | 1s | - |
| T065-D03-411- | 132kV 1-2 BUS SECTION BAY | 21/03/2018 | 2000A | 31.5kA | 1s | Unable to check, planning to confirm, unlikely |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | limiting full load flow for both transformers. |
| T065-D04-7119 | 7119 FEEDER BAY | 01/07/1982 | 773A | 25kA | 1s | Transmission line winter emergency rating is 767.3 A. |
| T065-D05-442- | 132kV 2 TRANSF BAY | 01/07/1982 | 1250A | 25kA | 1s | Adequately rated, limited by the disconnector, but not limiting use of full short term loading of power transformer. |
| T065-D06-7175 | 7175 FEEDER BAY | 01/07/1986 | 773A | 31.5kA | 1s | Transmission line winter emergency rating is 400 A. |
| T065-D51-7336 | 7336 FEEDER BAY 132kV | 01/07/2009 | 1000A | 40kA | 1s | Transmission line winter emergency rating is 623.4 A. |
| T065-D52-481- | 132kV 1 CAPACITOR BAY | 27/01/2004 | 1,046A | 40kA | 1s | - |
| T065-D53-412- | 1-3 BUS SECTION BAY 132KV | 11/04/2008 | 3000A | 40kA | 1s | Unable to check, planning to confirm, unlikely to be limiting any flows. |
| T065-D54-7152 | 7152 FEEDER BAY 132kV | 28/03/2008 | 1600A | 40kA | 1s | Transmission line winter emergency rating is 777.9 A. |
| T065-D55-443- | 3 TRANSFORMER BAY 132kV | 28/03/2008 | 1600A | 40kA | 1s | Adequately rated, not limiting use of full short term loading of power transformer. |
| T065-D56-7320 | 7320 FEEDER BAY 132kV | 28/03/2008 | 1600A | 40kA | 1s | Transmission line winter emergency rating is 800 A. |
| T065-KD—KD1- | 132kV 1 BUS | 05/07/1999 | 2,425A | 25kA | 1s | Unable to check, planning to confirm |
| T065-KD--KD2- | 132kV 2 BUS | 05/07/1999 | 2,425A | 25kA | 1s | Unable to check, planning to confirm. |
| T065-KD--KD3- | 132kV 3 BUS | 05/07/1999 | 2,400A | 40kA | 1s | Unable to check, planning to confirm. |
| T065-M02-444- | 2 SVC 132kV 4 TRANSFORMER BAY | 31/07/2009 | 1,838A | - | - | - |

All equipment at this substation is rated adequately for the calculated fault levels at present.

## *1.3 Asset age*

The Alligator Creek 132 kV substation was established in 1982. Some of the high voltage equipment has been replaced in 2008, 2009, and 2014. However, there are still high voltage equipment in service that was originally installed during the substation's establishment, making it 42 years old.

Major upgrades in the last 20 years include:

- CP.02695 T065 Alligator Creek 1-2 Bus Section Bay
- CP.01346 – Alligator Creek Substation Extension (QR Mackay Port)
- CP.01080 – Alligator Creek 132 kV Capacitor Bank
- CP.01251 – Alligator Creek 132 kV SVC
- CP.02800 – Alligator Creek 2T Primary Plant Replacement
- CP.01344 - Alligator Creek Substation Extension Louisa Creek

  And a number of other projects related to power transformers, access road, circuit breaker replacements, oil separation systems, etc.

### *1.4 Scope of site condition assessment*

The site condition assessment is restricted to the following high voltage equipment and associated support structures owned by Powerlink:

- T065-D06-7175 - 7175 FEEDER BAY
- T065-D01-7319 - 7319 FEEDER BAY (Desktop Condition Assessment)
- T065-D05-442 - 2T transformer bay (Desktop Compliance Assessment)

## 2. CONDITION ASSESSMENT

### *2.1 Substation*

With respect to the civil and structural aspects of this bay no intervention is required, however, some minor maintenance is recommended.

During this investigation it was confirmed that according to the Asbestos Register, there are asbestos containing materials in this site. The Asbestos Register shall be consulted before any maintenance work or project activities are planned & performed.

### *2.2 132kV Switching Bays*

#### *2.2.1 T065 - D06 - 7175 – 7175 FEEDER BAY*

This bay, constructed in 1986, has retained all its original equipment except for the Phase-C capacitor voltage transformer, which was replaced in 2015 due to secondary voltage failure. The equipment for this bay, along with their condition assessment health indices, is detailed in Table 2.

**Table 2 – T065-D06-7175 Equipment**

| Functional Loc. | Description | Model number | Start-up date | Manufacturer | Equipment | HI |
|---|---|---|---|---|---|---|
| T065-D06-7175-5VTA | CAPACITOR VOLTAGE TRANSFORMER | CVE145/650 | 30/09/1986 | HAEFELY | 20008298 | 9 |
| T065-D06-7175-5VTB | CAPACITOR VOLTAGE TRANSFORMER | CVE145/650 | 30/09/1986 | HAEFELY | 20008296 | 9 |

| | | | | | | |
|---|---|---|---|---|---|---|
| T065-D06-7175-5VTC | CAPACITOR VOLTAGE TRANSFORMER | TCVT145C | 04/11/2015 | TRENCH LIMITED | 20077313 | 3 |
| T065-D06-7175-71750 | EARTH SWITCH | AMB145 | 30/09/1986 | SIEMENS | 20011658 | 7 |
| T065-D06-7175-71751 | ISOLATOR | SSBIII-145 | 30/09/1986 | SIEMENS | 20011675 | 7 |
| T065-D06-7175-71752 | CIRCUIT BREAKER | 120-SFM-32A | 31/01/1985 | MITSUBISHI | 20008248 | 8 |
| T065-D06-7175-71753 | ISOLATOR | SSBIII-145 | 30/09/1986 | SIEMENS | 20011676 | 7 |
| T065-D06-7175-7175CTA | CURRENT TRANSFORMER | MODEL325 | 10/02/1983 | MODERN PRODUCTS | 20008257 | 9 |
| T065-D06-7175-7175CTB | CURRENT TRANSFORMER | MODEL325 | 10/02/1983 | MODERN PRODUCTS | 20008256 | 9 |
| T065-D06-7175-7175CTB | CURRENT TRANSFORMER | MODEL325 | 10/02/1983 | MODERN PRODUCTS | 20008255 | 9 |
| T065-D06-7175-7175SAA | SURGE ARRESTOR (GAPLESS) | ZLA-X15S | 01/07/1987 | HITACHI | 20011709 | 9 |
| T065-D06-7175-7175SAB | SURGE ARRESTOR (GAPLESS) | ZLA-X15S | 01/07/1987 | HITACHI | 20011710 | 9 |
| T065-D06-7175-7175SAC | SURGE ARRESTOR (GAPLESS) | ZLA-X15S | 01/07/1987 | HITACHI | 20011711 | 9 |

#### 2.2.1.1 T065 - D06 - 7175 – 71752 CIRCUIT BREAKER

The MITSUBISHI live tank circuit breaker (CB) unit is a GAS-insulated breaker with a porcelain housing. It features a pneumatic operating mechanism with a spring for energy storage and uses SF6 gas for insulation. This CB has been in operation for 37 years and has recorded 300 operations on its counter. This model is no longer in production, complicating spare parts sourcing. Currently, there are 30 of these circuit breakers still in service, with three scheduled for replacement under projects CP.02100 and CP.01015. Majority of these circuit breakers including this one also have internal wiring insulation deterioration due to the UV exposure. Currently, a spare breaker is available.

The maintenance records indicate a single air leak which has been fixed by the maintenance crew. During the site visit, repairs of air leaks at multiple locations were noted, as shown in figure 4.

In addition to the fixed air leak, multiple rusted bolts and washers on all three poles were reported and are scheduled to be addressed during the 2025 service. The operation counter also exhibits significant corrosion and needs replacement. These issues were observed during the site inspection, as indicated in figures 5 through 8. There is also internal wiring deterioration as per figure 9.

Although there is no major maintenance concern, the obsolescence of the **Kaji** air compressor and the unavailability of spare parts pose significant risks.

**Considering the current equipment strategy preference for Dead Tank Circuit Breaker (DTCB), it is recommended to replace this CB along with current transformers (CTs) with DTCB within two years to ensure safety risks associated with current transformers**

**remain acceptable. Additionally, the foundation and support structure will also need to be replaced.**

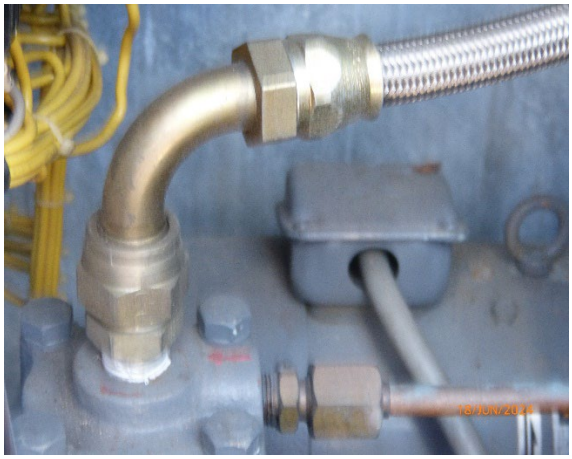



Figure 4- Repair of Air Leaks at Multiple Locations


Figure 5- Overview of 71752 indicate multiple corrosion


Figure 7- Grade 1 to Grade 3 Corrosion


Figure 6- Operation Counter Corrosion

Figure 8- Mid points bolts and nuts corrosion

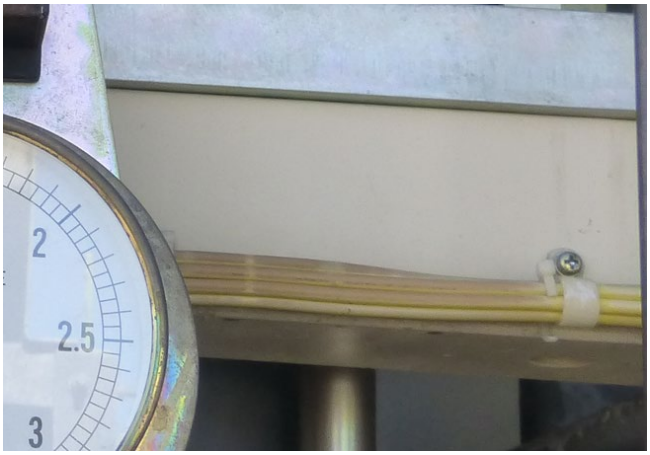



Figure 9- Insulation UV damage

#### 2.2.1.2 T065 - D06 - 7175 – 71750 EARTH SWITCH

The Earth switch, manufactured by Siemens (Model AMB145), was installed in 1986 and has been in continuous operation for 38 years. Maintenance records document number of notifications concerning worn bushings stopping correct travel, which required replacement of the bushing in 2019. Additionally, corrosion was reported on the main operating arm and U-bolt nuts in 2016, with remedial actions completed in 2018. At present, the U-bolts on the drive arms exhibit significant corrosion and require replacement. This issue remains unresolved to date.

#### 2.2.1.3 T065 - D06 - 7175 – 71751/3 ISOLATOR

The line and bus isolators are Siemens model SSBIII-145 and have been in service for 38 years. Maintenance records indicate that both the bus isolator 71753 and line isolator 71751 have experienced reoccurring issues, primarily related to corrosion and high contact resistance. For bus isolator 71753, surface rust has been detected on various components, including bolts and nuts holding the fixed insulators to the post plates. These issues were noted in 2012, 2016, 2022, and 2023, leading to periodic treatments and replacements. High contact

resistance was identified in phases A, B, and C of the bus isolator in 2016, which has been addressed by maintenance interventions.

Similarly, line isolator 71751 has been subjected to ongoing maintenance due to rust and operational stiffness. Surface rust on bolts and components was reported in 2009, 2012, and 2021, with treatments planned during scheduled outages. In 2017, stiffness in the operation of the isolator led to cleaning and lubrication of its components. Additionally, high contact resistance was also found in the line isolator, which was fixed by contacts removal and cleaning. A hot joint on the C phase of line isolator 71751 was reported in October 2023, requiring further investigation and repairs. Ongoing monitoring and future scheduled repairs are planned, with actions deferred until the next major outage in 2025.

Siemens has stopped manufacturing these disconnectors and earth switches, leading to significant challenges in obtaining product support and spare parts**. It is recommended to replace the disconnectors and earth switches, along with their foundations if necessary, within the next two years, in conjunction with the circuit breaker replacement.**

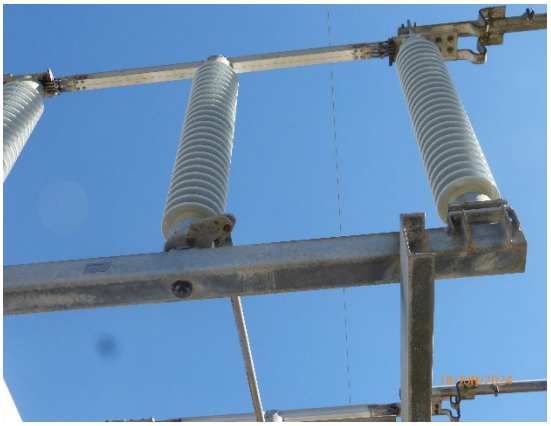




Figure 10- Corrosion on 132kV Bus Isolator 71753 Components

#### 2.2.1.4 T065 - D06 - 7175 – 7175CT CURRENT TRANSFORMERS

The current transformers are Modern Products MODEL325, oil-filled, porcelain insulated, hermetically sealed design utilizing a gas cushion. Installed in 1986, these current transformers have been in continuous operation for 41 years. Seven identical units were replaced mainly due to oil leaks, with no catastrophic failures recorded. Additionally, nine units have been retired or mothballed along with their respective bays.

Routine oil sample analysis has not detected any abnormalities, and levels of key dissolved gases and moisture remain within acceptable limits.

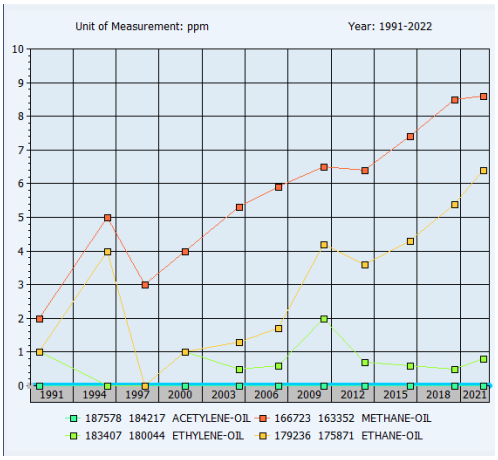



Figure 11- Key Dissolved Gases in Oil-PH-A

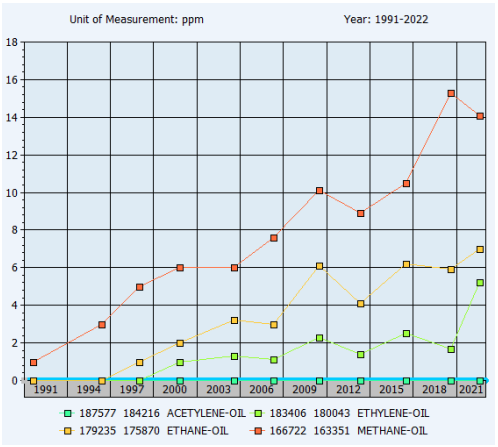



Figure 12- Key Dissolved Gases in Oil-PH-B

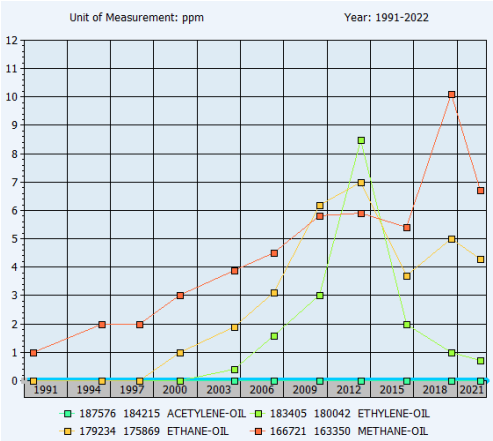



Figure 13- Key Dissolved Gases in Oil-PH-C

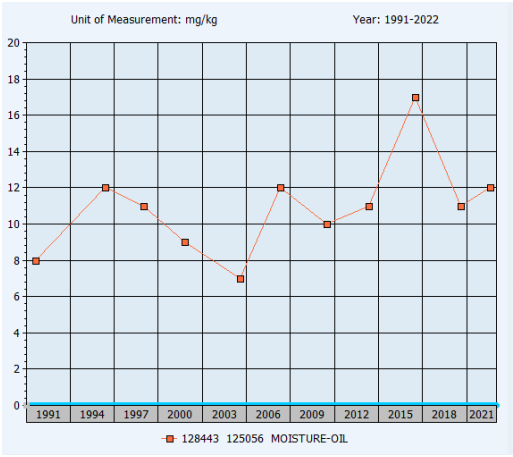



Figure 14- Moisture in Oil-PH-A

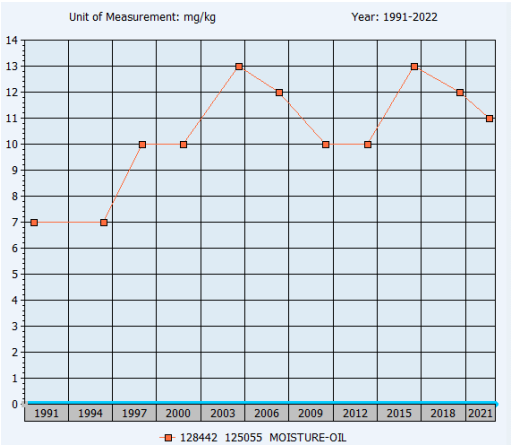



Figure 15- Moisture in Oil-PH-B

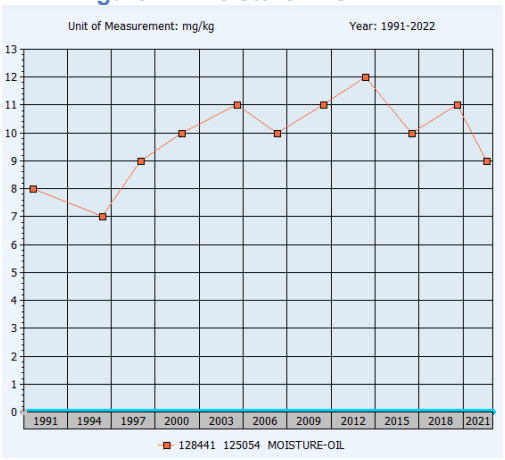



Figure 16- Moisture in Oil-PH-C

Maintenance records indicate no issues with these current transformers since their installation. The oil levels for all three phases were noted to be normal during the site inspection. Minor corrosion was observed on several bolts and nuts across the three phases (Figures 16-18).


Figure 17-Current Transformers overall View


Figure 18- Corrosion on CT Fittings


Figure 19- Corrosions on bolts and nuts

While they appear to be in reasonable condition and their DGA analyses are satisfactory, it is known considering their age that there is increased probability of explosive failures. Considering these are oil filled CTs in porcelain housing the potential safety consequences of catastrophic failure represent an unacceptable risk.

**It is recommended that these current transformers be replaced within two years.**

#### 2.2.1.5 T065 - D06 - 7175 – 5VT VOLTAGE TRANSFORMER

The capacitive voltage transformers (CVTs) are of HAEFELY make, featuring porcelain housing construction, and have been in service for 38 years. Notably, the original porcelain-housed C phase voltage transformer (VT) was replaced with a polymer-housed VT in 2015 and is currently in good condition. Except for the reported oil leak from the A phase gauge since 2022, maintenance records indicate no significant concerns. The oil colour in phases A and B has changed to reddish-brown, indicating potential moisture ingress whereas the oil in phase C remains clear.


Figure 20- C- Voltage Transformer with Clear Oil


Figure 21- A- Voltage Transformer with Dark Oil



Figure 22- B- Voltage Transformer with Dark Oil

**Given the observed condition, it is recommended to replace the A and B phase voltage transformers within the next two years.**

#### 2.2.1.6 T065 - D06 - 7175 – 7175SAA SURGE ARRESTORS

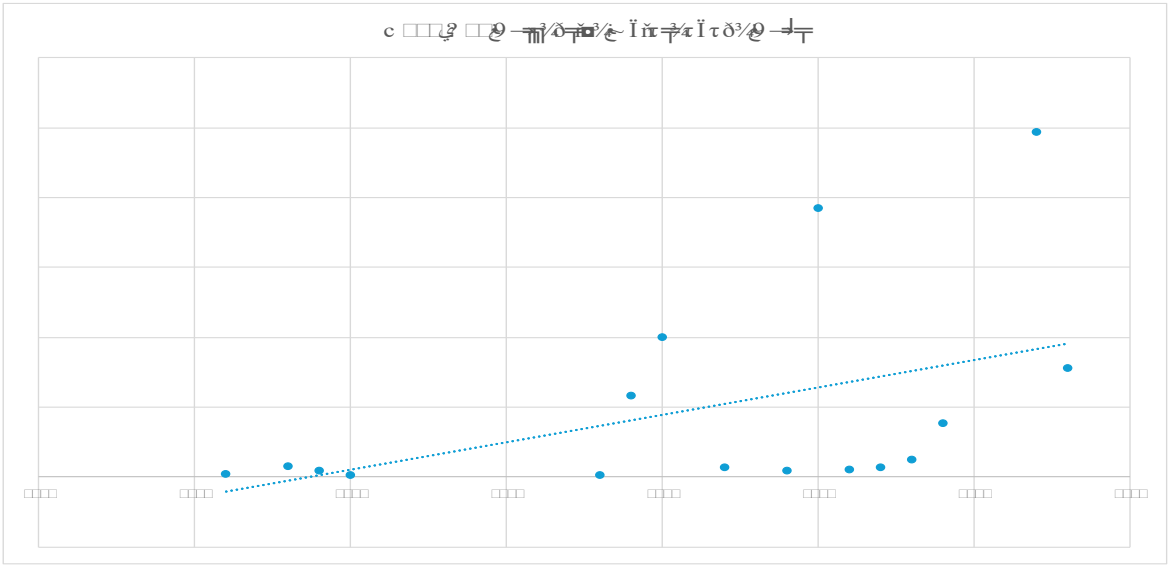
The surge arrestors are of Hitachi make, gapless type in porcelain housing and have been in service for 37 years. Apart from corrosion at the steel work at the base of phase A and some rusty bolts require replacement, the arrestors are in reasonable condition. **Considering they**

**are in porcelain housing and the need to renew almost all other equipment in this bay**, **it is recommended to have these replaced.** Their potential failure can result in safety risk, damage to the surrounding equipment, causing outages and either supply disruptions or supply to the customer being put on risk.

Figure 23- Corrosion at surge arrestor bolts and steel work

### *2.2.2 Corrective Maintenance Cost*

#### 2.2.2.1 T065-D06-7175 Bay Maintenance Cost



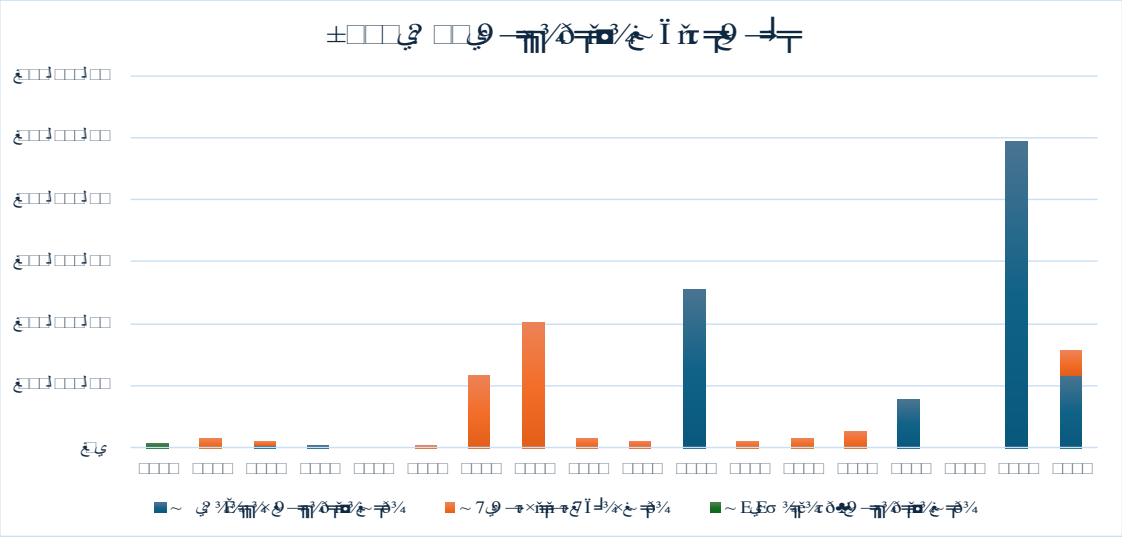


Figure 24 - H065-D06 Corrective Maintenance Cost

The corrective maintenance costs associated with this bay have exhibited an increasing trend over time. Critical components contributing to these increasing costs include the CVTs (Capacitive Voltage Transformer) and the isolators. Notably, a significant expenditure was incurred in 2015 for the replacement of the C phase voltage transformer. From 2016 onwards, the corrective maintenance costs were predominantly influenced by the bus and line isolators, addressing corrosion and high contact resistance defects.

### *2.2.3 Future Operation Requirements*

- Feeder 7175 is sole supply to T105 Oonooie which remains an active Aurizon site.
- Network studies confirm an enduring need for Oonooie substation while the Aurizon connection remains active, consequently there is a need for corrective action.
- Currently, a new project, CP.02320, is being estimated, the objective of this project is to undertake necessary works for Oonooie substation primary plant and secondary systems to extend the life of the substation from 2022 to 2042. Which emphasise the criticality of maintaining the reliability of the feeder bay (T065-D06-7175) as the single supply to the substation.

### *2.2.4 T065-D01-7319- 7139 FEEDER BAY*

Since its construction in 1983, this bay has seen several upgrades. In 2008, a new circuit breaker was installed, transforming it into a fully switchable bay. Additionally, the phase A Capacitor Voltage Transformer (CVT) was replaced that same year. In 2022, the gapless surge arrestors were also replaced. These newer pieces of equipment are not included in the scope of the condition assessment.

The original phase B and C voltage transformers, alongside the isolators and earth switches are the original equipment and have been in service for 42 years. Table 3 details the equipment for this bay, including their condition assessment health indices.

Table 3 – T065-D01-7319 Equipment

| Functional Loc. | Description | Model number | Start-up date | Manufacturer | Equipment | HI |
|---|---|---|---|---|---|---|
| T065-D01-7319-1VTA | CAPACITOR VOLTAGE TRANSFORMER | TEMP138C | 23/04/2008 | TRENCH LIMITED | 20055236 | 7 |
| T065-D01-7319-1VTB | CAPACITOR VOLTAGE TRANSFORMER | TEMS138 | 10/02/1983 | TRENCH ELECTRIC | 20008302 | 8 |
| T065-D01-7319-1VTC | CAPACITOR VOLTAGE TRANSFORMER | TEMS138 | 10/02/1983 | TRENCH ELECTRIC | 20008295 | 8 |
| T065-D01-7319-73190 | EARTH SWITCH | TYPE KL | 10/02/1983 | BONAR STANGER | 20011657 | 7 |
| T065-D01-7319-73191 | ISOLATOR | RDB | 10/02/1983 | BONAR STANGER | 20008265 | 7 |
| T065-D01-7319-73192 | CIRCUIT BREAKER | HS145 ITEM 2GD 6CORE | 28/03/2008 | GE HITACHI HVB | 20058117 | 5 |
| T065-D01-7319-73193 | ISOLATOR | RDB | 10/02/1983 | BONAR STANGER | 20008272 | 7 |
| T065-D01-7319-7319SAA | SURGE ARRESTOR (GAPLESS) | PEXLIM R120-XH145 | 01/07/2022 | ABB SWITCHGEAR | 20132227 | 3 |
| T065-D01-7319-7319SAB | SURGE ARRESTOR (GAPLESS) | PEXLIM R120-XH145 | 01/07/2022 | ABB SWITCHGEAR | 20132228 | 3 |
| T065-D01-7319-7319SAC | SURGE ARRESTOR (GAPLESS) | PEXLIM R120-XH145 | 01/07/2022 | ABB SWITCHGEAR | 20132229 | 3 |

#### 2.2.4.1 T065 - D05 - 7319 – 73190 EARTH SWITCH

The Earth switch, manufactured by Bonar Stanger (TYPE KL), was installed in 1983 and has been in continuous operation for 42 years. In 2201, SAP records indicated the development of corrosion, specifically at the threaded linkage, as shown in Figure 24 from the SAP notification. This issue was addressed by replacing the A and C phases pivot arms in 2022 and the C phase in 2023. Currently, the fixed contact supports and guides exhibit G1 corrosion (Figure 25) and are planned to be attended to during the next planned outage in 2027.

Figure 25- Corrosion on 132kV ES 73190 Pivot arm


Figure 26- Corrosion on 132kV ES 73190 fixed contact supports and guides

#### 2.2.4.2 T065 - D01 - 7319 – 73191/3 ISOLATOR(s)

The line and bus isolators are Bonar Stager model RDB and have been in service for 42 years. Maintenance records indicate that the line isolator 73191 has experienced ongoing corrosion issues over an extended period of time. Initial concerns date back to 2013, with multiple observations noting significant rust development on bolts, pivot pins, and contact areas. Over the years, rust severity has varied, with some components requiring immediate replacement while others were monitored for gradual deterioration. In August 2023, rusted bolts and nuts,

were replaced during scheduled outage. Despite these efforts, rust remains a recurring issue, prompting continued monitoring. The next scheduled outage for comprehensive maintenance is planned for February 2027, with provisions to address severe cases beforehand if necessary.


Figure 27- Corrosion on 132kV Isolator 73191

Similarly, the structural nuts, bolts, and pivot pins of the bus isolator 73193 have exhibited persistent corrosion issues over several years, requiring multiple maintenance interventions. Initial reports from 2009 highlighted corrosion on structural bolts and auxiliary switch linkage, with further deterioration noted in subsequent assessments. Various maintenance activities, including bolt replacements and rust treatment, have been performed, notably in 2013, 2019, and most recently in September 2023, when the crew replaced rusted pivot pins. Despite these efforts, periodic inspections continue to identify rust-related concerns, necessitating ongoing monitoring and maintenance planning. The issue has been bundled with other defect notifications to align with future bus outages for efficient rectification.

**Although the various corrosion issues reported in the isolators and earth switch being repairable and/or replaceable components, Feeder F7319 is the only supply for Mackay Ports and Louisa Creek substations which are relatively new and expected to be required for many years. Therefore, it is recommended to replace these isolators and earth switches together with replacement of CVTs, to ensure long-term reliability of the feeder.**

#### 2.2.4.3 T065 - D01 - 7319 – 1VT VOLTAGE TRANSFORMER

The capacitive voltage transformers (CVTs) are manufactured by TRENCH and feature porcelain housing construction. The phase A CVT was replaced in 2008 with a new model featuring a polymer housing, while phases B and C are the original equipment and have been in service for 42 years. These CVTs do not have a sight glass or an oil level indicator to visually inspect the oil level or oil colour.

Powerlink's Trench CVTs have a high failure rate, with only about 60% of the installed equipment still in service. **Due to this high failure rate, it is recommended that all three CVTs be replaced within the next two years.**

### *2.2.1 T065-D05-442- 132kV 2 TRANSF BAY (Special Recommendations-Compliance Based)*

The pieces of equipment for this bay are detailed in the below Table 4.

Table 4 – T065-D05-442- Equipment

| Functional Loc. | Description | Model number | Start-up date | Manufacturer | Equipment | HI |
|---|---|---|---|---|---|---|
| T065-D05-442--2SAA | SURGE ARRESTOR (GAPLESS) | 3HSRCP120L27E27M3-22 | 19 | BOWTHORPE EMP | 20058107 | 2.00 |
| T065-D05-442--2SAB | SURGE ARRESTOR (GAPLESS) | 3HSRCP120L27E27M3-22 | 19 | BOWTHORPE EMP | 20058108 | 2.00 |
| T065-D05-442--2SAC | SURGE ARRESTOR (GAPLESS) | 3HSRCP120L27E27M3-22 | 19 | BOWTHORPE EMP | 20058109 | 2.00 |
| T065-D05-442--2TRFCTA | CURRENT TRANSFORMER | TG145 | 6 | ABB | 20125528 | 2.00 |
| T065-D05-442--2TRFCTB | CURRENT TRANSFORMER | TG145 | 6 | ABB | 20125529 | 2.00 |
| T065-D05-442--2TRFCTC | CURRENT TRANSFORMER | TG145 | 6 | ABB | 20125530 | 2.00 |
| T065-D05-442--4420 | EARTH SWITCH | KL-R | 43 | BONAR STANGER | 20008264 | 5.00 |
| T065-D05-442--4422 | CIRCUIT BREAKER | LTB145D1/B | 19 | ABB SWEDEN | 20060436 | 4.00 |
| T065-D05-442--4423 | ISOLATOR | RDB | 43 | BONAR STANGER | 20008268 | 6.00 |

However, the current transformers in this bay were replaced in 2020. These current transformers, along with the circuit breaker, do not meet the electrical clearances required for 132kV equipment according to Powerlink specifications. **Therefore, they should be replaced. The only way to meet these clearance requirements is to replace the circuit breaker with a dead tank circuit breaker, which will eliminate the need for post-type current transformers. Additionally, the decommissioned equipment should be recovered and maintained as spares.**

# 3. RECOMMENDATION:

## *3.1 T065 - D06 - 7175 – 7175 FEEDER BAY*

F7175 connects Alligator Creek to Oonooie substation, supplying the Aurizon network (CAA extended to 2032 with two provisions for five-year extensions). Due to the critical operational role of F7175 as the sole supply to Oonooie, a comprehensive replacement strategy should be considered for both T065-D06 and the associated equipment at T105-D04.

It is recommended that all critical bay equipment at T065-D06, including the circuit breaker, current transformers, voltage transformers, isolators, earth switch, and surge arrestors at T105-D04 be replaced as part of a comprehensive project. This recommendation is based on observed conditions such as corrosion, oil degradation, and the obsolescence of components, which pose significant reliability risks.

### *3.2 T065-D01-7319- 7139 FEEDER BAY*

Replace the CVTs at this T065-D01 to mitigate the consequences of in-service failure and unplanned shutdown on the network.

Despite the various corrosion issues reported in the isolators and earth switch being repairable and/or replaceable components, it is recommended to replace them as this bay is a single source of supply for Mackay Port and Louisa Creek substations. Therefore, it is likely that these will be required longer than their expected estimated remaining service life of 10-15 years.

It is recommended to continue monitoring the condition of the equipment, associated structures, and foundations in this bay for the next 10 years. Regular visual inspections and any necessary maintenance actions should be undertaken to ensure continued reliable operation.

### *3.3 T065-D05-442- 132kV 2 TRANSF BAY*

Given the noncompliance with Powerlink specifications for electrical clearances, it is advisable to replace the circuit breakers and current transformers with a dead tank circuit breaker.

## 4. ASSET CONDITION ASSESSMENT OVERVIEW

**Table 5 - Recommendations**

| Asset | Asset Replc. Recom. (Y/N) | Recom. Replc. timing (yrs) | Refurb. Recom. (Y/N) | Corr. Maint. Rec. (Y/N) | Recommendations |
|---|---|---|---|---|---|
| T065 - D06 - 7175 – 71752 | Y | 2 | N | Y | Continue essential maintenance, but plan for replacement within 2 years. |
| T065-D06-71751/3 Isolators | Y | 2 | N | Y | Continue with essential maintenance until replacement |
| T065-D06-7175CT | Y | 2 | N | Y | Monitor closely for potential emergency replacement. The CTs are oil-filled porcelain, increasing the risk of catastrophic failure after 41 years of service. Replacement within 2 years is recommended. |
| T065-D06-7175 5VT | Y | 2 | N | Y | Monitor closely for potential emergency replacement. Plan to |

| Asset | Asset Replc. Recom. (Y/N) | Recom. Replc. timing (yrs) | Refurb. Recom. (Y/N) | Corr. Maint. Rec. (Y/N) | Recommendations |
|---|---|---|---|---|---|
| | | | | | replace phases A&B within 2 years is recommended. |
| T065-D06-7175SAA | Y | 2 | N | Y | Consider replacing the surge arrestors within 2 years, as their failure could impact surrounding equipment. Continue maintenance in the interim. |
| T065-D06-7175-71750 | Y | 2 | N | Y | Significant corrosion noted on U-bolts and operating arms. Plan for replacement within 2 years while continuing maintenance in the interim. |
| T065-D01-7319-1VTA | Y | 2 | N | Y | Continue essential maintenance, but plan for replacement within 2 years. |
| T065-D01-7319-1VTB | Y | 2 | N | Y | Continue essential maintenance, but plan for replacement within 2 years. |
| T065-D01-7319-1VTC | Y | 2 | N | Y | Continue essential maintenance, but plan for replacement within 2 years. |
| T065-D01-7319-73190 | Y | 2 | N | Y | Continue monitoring the condition of the equipment, associated structures, and foundations in this bay, but plan their replacement along with CVTs to ensure continued reliable operation for longer than 10-15 years. |
| T065-D01-7319-73191 | Y | 2 | N | Y | Continue monitoring the condition of the equipment, associated structures, and foundations in this bay, but plan their replacement along with CVTs to ensure continued reliable operation for longer than 10-15 years. |

| Asset | Asset Replc. Recom. (Y/N) | Recom. Replc. timing (yrs) | Refurb. Recom. (Y/N) | Corr. Maint. Rec. (Y/N) | Recommendations |
|---|---|---|---|---|---|
| T065-D01-7319-73193 | Y | 2 | N | Y | Continue monitoring the condition of the equipment, associated structures, and foundations in this bay, but plan their replacement along with CVTs to ensure continued reliable operation for longer than 10-15 years. |
| T065-D05-442--2TRFCTA | Y | 2 | N | Y | Continue with routine maintenance as necessary until the circuit breaker is replaced with a Dead Tank Circuit Breaker (DTCB). Decommission, recover and maintain as spare |
| T065-D05-442--2TRFCTB | Y | 2 | N | Y | Continue with routine maintenance as necessary until the circuit breaker is replaced with a Dead Tank Circuit Breaker (DTCB). Decommission, recover and maintain as spare |
| T065-D05-442--2TRFCTC | Y | 2 | N | Y | Continue with routine maintenance as necessary until the circuit breaker is replaced with a Dead Tank Circuit Breaker (DTCB). Decommission, recover and maintain as spare |
| T065-D05-442--4422 | Y | 2 | N | Y | Continue with routine maintenance as necessary until the circuit breaker is replaced with a Dead Tank Circuit Breaker (DTCB). Decommission, recover and maintain as spare |

# 5. REFERENCE INFORMATION

- *Condition Assessment Photos*

*K:\SubstationPhotos\Alligator Creek - needs photos\Sub-CA-20240618*

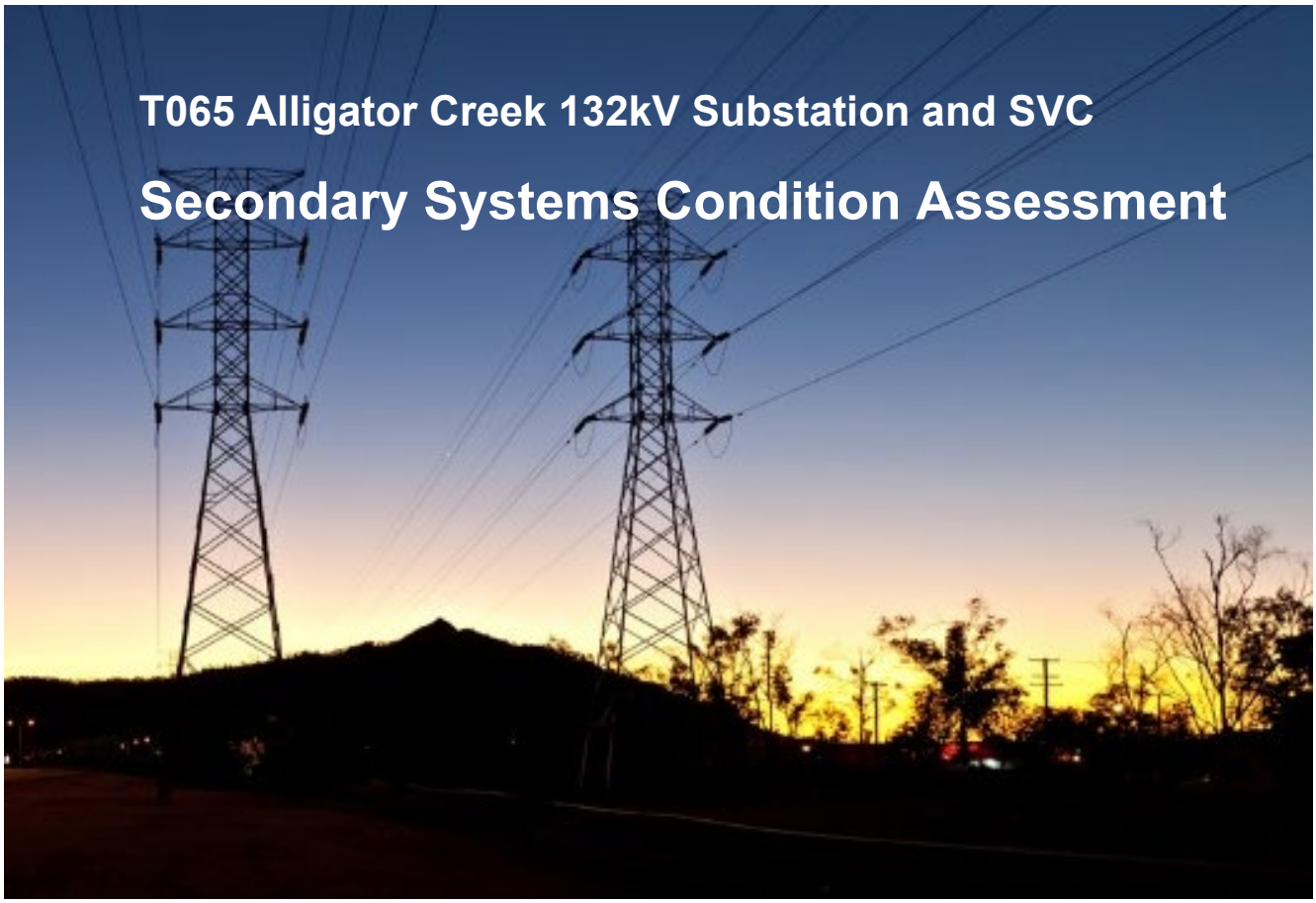
- *Equipment list (SAP)*
- *Notifications, work orders and measurement documents (SAP)*
- *Operating diagram*
- *132, 33, 26.2 & 11 kV bay ratings*
- *Powerlink drawings*

# 6. APPENDIX

## *6.1 Replacement Index Methodology*

*Replacement index for bays and other substation assets is based on the condition of the equipment in the bay, condition of structures and foundations (all being assigned health index as condition indicator), ay voltage level and type, bay location criticality and bay compliance with legislation and standards. It provides an indication of the remaining life based on its condition and criticality, rather than based on it time in service.*

| RI | Estimated Remaining Life(yrs) | Action | Comment | Comment |
|---|---|---|---|---|
| 10 | 1 -2 | condition assessment required on annual basis (or special maintenance regime) | project scoped and approved, included in the current Reset period | **Poor condition needs urgent action.** |
| 9 | 2-3 | condition assessment required on annual basis (or special maintenance regime) | project scoped and in final approval stages, included in the current Reset period | Poor condition, needs prompt, planned action. |
| 8 | 3 - 5 | condition assessment required on annual basis (or special maintenance regime) | project scoping, options analysis | |
| 7 | 5 - 10 | high level project scoped | high level project scoped for regulator, condition assessment done | |
| 6 | 10 - 20 | condition assessment trigger | Condition assessment to be done within 1 year and ready for next Reset, scope project before next Reset | Deteriorating condition, future replacement required, but in a planned fashion. |
| 5 | 20 - 25 | plan condition assessment in 5 yrs | | Aged condition, but satisfactory. |
| 4 | 25 - 30 | mid life condition assessment (desktop) | Desktop assessment of notified issues | Needs some replacements, typically only few, minor components |
| 3 | 30 - 35 | annual review of HI and RI begins | aging - good condition | |
| 2 | 35-40 | good condition, annual review of notifications, dealing with infant mortality issues | | |
| 1 | ≥40 | New | | |




| | | | |
|---|---|---|---|
| **Date of Site Visit:** | 30/10/2023 | | |
| **Authored by:** | Senior Digital Asset Strategies Engineer | [redacted] | RPEQ:08244 |
| **Reviewed by:** | Senior Secondary System Strategies Engineer | [redacted] | RPEQ:13131 |
| **Approved by:** | Team Leader SS&TS | [redacted] | |

Version history

| Version | Date | Section(s) | Summary of amendment | Author | Approver |
|---|---|---|---|---|---|
| 1.0 | 30/05/2024 | All | Original Document | [redacted] | [redacted] |
| | | | | | |

# Table of Contents

# 1 Purpose

This condition report covers T065 Alligator Creek 132kV substation secondary systems and associated site infrastructure. It is produced to assist with determining the future asset strategies and the scope for refurbishment and replacement work of T065 Alligator Creek secondary system assets.

# 2 Scope

The report is based on the site inspection conducted on 18/04/2023 and with inputs from the following attendees:

| Team | Position | Name |
| --- | --- | --- |
| Secondary Systems & Telecommunications Strategies | Senior Secondary System Strategies Engineer | [redacted] |
| Secondary Systems & Telecommunications Strategies | Senior Digital Asset Strategies Engineer | [redacted] |

The report also considers data extracted from SAP, SPF, the Forced Outage Database (FOD) and discussion with maintenance staff. Photographs of items taken during the site visit have been stored in the folder, [redacted]

# 3 Condition Assessment Boundary and Methodology

## 3.1 Inclusions and Exclusions

### 3.1.1 Inclusions

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

- Secondary system cables – All cables that are associated with secondary systems and equipment, including:
  - Cables between control and protection panels and termination racks;
  - Cables between termination racks and yard marshalling kiosks, AC and DC kiosks.
- OpsWAN panels, system and equipment;
- Secondary system AC and DC supply – Low voltage (LV) AC Panel heaters and lights, DC batteries and chargers;
- Secondary system panels and associated ancillary parts, including links, terminals, Input / output modules, signal converters, transducers and power supplies;
- Indoor and outdoor secondary systems marshalling kiosks, AC and DC kiosks, termination racks, including internal links, terminals, MCBs and fuses;
- Indoor and outdoor control cables to outdoor secondary systems kiosks or cables from indoor secondary systems panels directly connected to primary equipment control kiosks;
- Secondary system equipment and systems, including protection relays, HMI computers, RTUs, data acquisition units, Programmable Logic Controllers (PLCs), Intelligent Electronic Devices (IED);
- Available space in existing control buildings to accommodate new secondary system panels.
- Telecommunication assets, including 50VDC batteries and chargers.
- OpsWAN cameras.
- AC auxiliary supply systems (> 230/400VAC), including transformers, diesel generators and building power and light circuits;

### 3.1.2 Exclusions

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

- Condition of control buildings and associated light and power circuits;
- Civil structures, cable trenches and foundations;
- 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;

### 3.2 Secondary System Condition Assessment Principles and Methodology

Principles of secondary systems condition assessment were based on Powerlink' s Secondary Systems Asset Risk Model and Powerlink – Asset Risk Management – Framework.

The methodology consists of two main parts – Desktop assessment based and a site visual inspection.

The desktop assessment is limited only to assets recorded in SAP asset database, e.g. protection relays, RTUs and IEDs. It is important to note that a significant number of secondary systems equipment, including cables, kiosks, terminals, links, panels, termination racks, auxiliary equipment and some IEDs are not recorded in SAP. The condition assessment of these depends solely on 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 the equipment health indices based on the optimisation of risk, cost and performance of Powerlink's secondary assets since 1999. The 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 the end of their technical service life. Equipment with a health index close to ten represents only a moderate increased risk of functional failures, but significantly longer outage duration and higher risk of impacting system's availability and reliability.

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. It also takes into account of the criticality of equipment that are (or are not) directly associated with the performance of secondary systems. For example, OpsWAN equipment with health indices are close to ten may not need to be replaced urgently because their functions are considered to be non-critical to the secondary systems performance and as such may be replaced as the opportunity arises.

## 4 References

| Document code | Document Details |
| --- | --- |
| A3348092 | 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 |
| A3348084 | Powerlink – Asset Risk Management – Framework, ASM-I&P-FRA-A2417558, Powerlink Queensland, 21/12/2020 |
| A527892 | ASM-STD-A527892 Secondary Systems Design Standard, Powerlink Queensland, 10/01/2022 |
| A533375 | ASM-STD-A533375 OSD SCADA Requirements for Operational Purposes Standard, Powerlink Queensland, 24/04/202 |

| Document code | Document Details |
| --- | --- |
| A3372626 | ASM-ID&TD-STD-A3372626 SU0049 New Physical Disconnect Terminal for CT Circuits Supersedes SU0031, Powerlink Queensland, 12/06/2020 |
| A3385483 | ASM-SPE-A3385483 AM Substation Design Principles – Specification, Powerlink Queensland, 15/07/2021 |
| A4982111 | ASM-FRM-A4982111 ETR 10434011 OpsWAN camera lowering device task report. |

# 5 Monitoring and Compliance

Compliance with this document is mandatory and will be actively monitored by the Secondary Systems and Telecommunications Strategies Team.

# 6 Condition Assessment

## 6.1 Introduction

T065 132kV Alligator Creek Substation is located approximately 22km south of Mackay and was established in 1982. The switchyard includes a 132kV Powerlink section and a 33kV EnergyQld section. The substation provides supply to the EnergyQld distribution network (directly from the substation, but also at Louisa Creek), and Aurizon (at Oonooie and Mackay Ports substation).

The 132kV connected Powerlink SVC was established in 2009.

132kV Alligator Creek Substation Operational Diagram

T065 Alligator Creek Substation Powerlink owned primary equipment bays are showed in following table.

**Table 1 – T065 Alligator Creek Substation Network Elements**

| Local Substation (T065 Alligator Creek) | | | | | Remote Substation |
|---|---|---|---|---|---|
| | Voltage (kV) | Quantity | Bay Designation | Operational Element | |
| Feeders | 132 | 6 | =D06 | 7175 | T105 Oonooie (Powerlink) |
| | | | =D04 | 7119 | H011 Nebo (Powerlink) |
| | | | =D01 | 7319 | Louisa Creek (EnergyQld) |
| | | | =D51 | 7336 | QR Mackay Ports (A, C ph only) |
| | | | =D54 | 7152 | T141 Pioneer Valley |
| | | | =D56 | 7320 | Louisa Creek (EnergyQld) |
| Cap Bank | 132 | 1 | =D52 | 1 CAP | |
| SVC | 132 | 1 | =D02 | 2 SVC | |

| | | | | | |
|---|---|---|---|---|---|
| Busbars | 132 | 3 | | 1Bus, 2Bus, 3Bus | |
| Bus Couplers | 132 | 2 | =D03, =D53 | 4112, 4122 | |
| | | | | | |

The secondary systems design at T065 Alligator Creek is based on the SDM7 standard modular approach where each protection panel has its own RTU for bay control and alarming. Standard swing frame panels are used, and all CT and VT signals are derived from primary plant and connected to protection/control panels via associated marshalling kiosks.

## 6.2 Buildings

There are two Powerlink buildings at T065 Alligator Creek switching substation. The SVC yard pictured below has its dedicated combined building.


T065 132kV Alligator Creek Substation Aerial View

- Combined Amenities Building +1 (refer drg. N-408512-001)

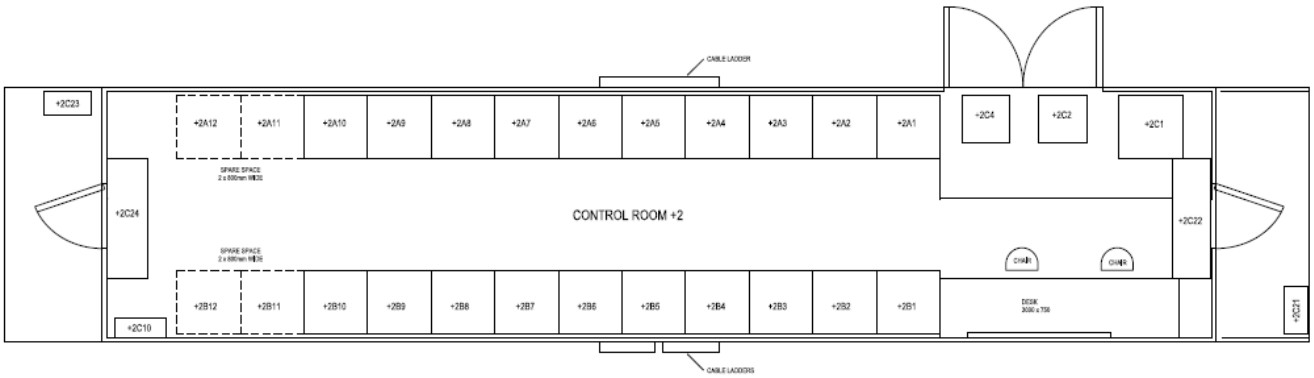
  This building was commissioned in 1982 and includes a control section with Ergon 33kV panels, Communications Room, Battery Room, Storage facility, Workshop, Amenities Room and toilet. Some parts of the building are air-conditioned: Control Room, Communications Room and a Battery Room. This building includes an AC distribution board.

Combined Amenities and Control building +1

- Control Building +2 (refer drg. -H-132588-001)

  The single level demountable control building established in 2008 under CP.01326 includes Powerlink protection and control panels, communications, revenue metering, an AC distribution board and a dual 125V DC System. 50V DC Telecommunications equipment is powered-off 125/50V DC converters. The control building is air-conditioned, free from dust, clean and is located within the substation perimeter fence. The building has been well maintained and is in good condition. There is satisfactory access to all panels. Details of control building +2 are summarised in Table 2.

Control building +2




T065 Alligator Creek control building +2 equipment layout, refer H-132588-001.

**Table 2 – Alligator Creek Substation Secondary System Building +2**

| Building Description | Designation | Functional Use | Spare Sec Sys Panel Spaces |
|---|---|---|---|
| Substation Secondary System & Communications Site Building | +2 | Secondary Systems Feeder Bay =D01 panel | **4 x spare panels:** +2A11, +2A12 +2B11, +2B12 |
| | | Secondary Systems Feeder/CB Mgmt Bay =D02 panel (SVC connection) | |
| | | Secondary Systems Feeder Bay =D04 panel | |
| | | Secondary Systems Feeder Bays =D06 panel | |
| | | Secondary Systems Feeder Bays =D51 panel | |
| | | Secondary Systems Feeder Bays =D54 panel | |
| | | Secondary Systems Feeder Bays =D56 panel | |
| | | Secondary Systems Coupler Bay =D03 panel | |
| | | Secondary Systems Coupler Bay =D53 panel | |
| | | Secondary Systems Cap Bank Bay =D52 panel | |
| | | Secondary Systems 2 T Bay =D05 panel | |
| | | Secondary Systems 3 T Bay =D53 panel | |
| | | Secondary Systems 1 BZ panel | |
| | | Secondary Systems 2 BZ panel | |
| | | Secondary Systems 3 BZ panel | |
| | | Power Quality Monitoring panel | |
| | | Station Cubicle - Station SCADA (NSC, LCF), Common RTU | |
| | | Metering panel 1 | |
| | | Metering panel 2 | |
| | | Communications cubicle | |
| | | AC distribution panel | |
| | | 125V DC X&Y System | |
| | | Air Conditioning Units | |
| | | Optical Fiber Junction Box | |
| | | | |
| | | | |

- SVC Building +3
  The SVC Building has been commissioned in 2009. It includes an air conditioned room for SVC control and protection panels and DC/AC distribution and a separate non air-conditioned room for the SVC switching equipment (thyristor valves, related equipment, valve cooling system). The building has been well maintained and is in good condition. There is also satisfactory access to all panels.

SVC Building +3

## 6.3 Outdoor Marshalling Kiosks

All substation existing marshalling kiosks were installed following a refurbishment in 2008. The kiosks are in serviceable condition and can be kept in service until 2048.

Some door seals and mesh filters, show signs of degradation and should be replaced as part of substation routine maintenance. Degraded door seals and air filters can lead to premature failures of internal components, e.g. links, terminals, follower relays etc. It is recommended that all outdoor marshalling kiosks be monitored as part of the substation routine inspection to identify any aggressive deteroration. An operational project (or maintenance work order) should be initiated to replace the internal components if they show signs of deterioration beyond Powerlink's safety standards.

Health Indices of secondary system outdoor marshalling kiosks and recommended replacement timeframe have been detailed in Section 9 **Appendix A**. Physical appearance of typical outdooor marshalling kiosks are illustrated in Section 3.5.1- Section 3.5.5.

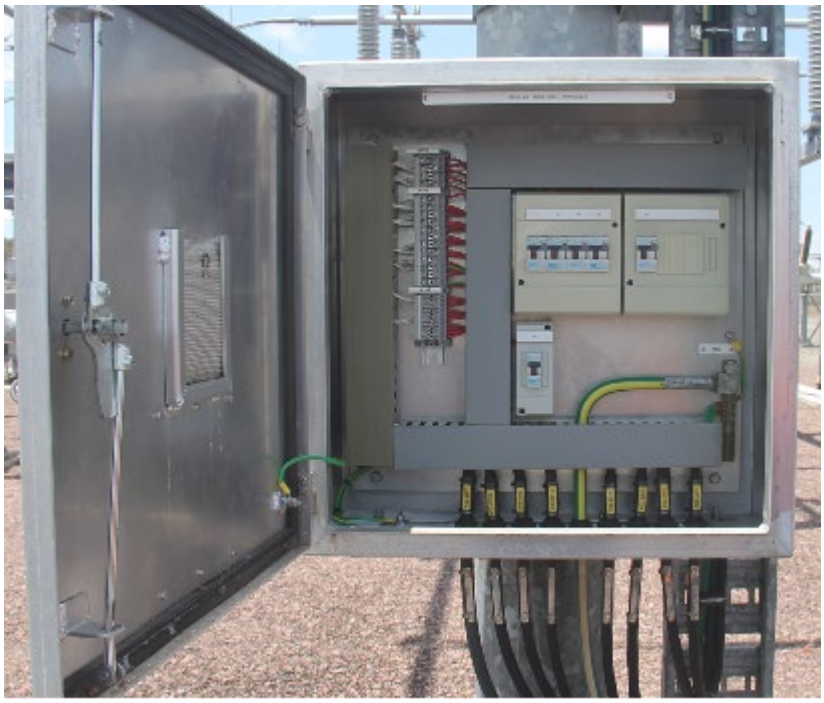
Although there is no condition driven replacement required on substation outdoor marshalling kiosks, all associated CT links shall be replaced to mitigate safety risks according to SU0049 New physical disconnect terminal for CT circuits.

In addition, all CT links associated with HV plant interface kiosks (for Pass M0, CBs in general, transformers, etc.) shall to be replaced according to SU0049.

### 6.3.1 Bay Marshalling Kiosks

+D05-A10 marshalling kiosk (used as an example for similar items on site)

### 6.3.2 Voltage Transformer Marshalling Kiosks



+KD3-A13 marshalling kiosk (8VT, used as an example for similar items on site)

### 6.3.3 Other Marshalling Kiosks

The Power Quality Monitoring isolation kiosks +KD1-A13A, –A13B and –A13C appear of a lower specification and are affected by corrosion. These kiosks shall be replaced as part of a major secondary system replacement in that bay.

### 6.3.4 Control Building Termination Racks

There are no building termination racks at T065 Alligator Creek substation. Secondary system cables are installed and terminated directly between the indoor panels and outdoor marshalling kiosks.

## 6.4 Outdoor secondary system multicore cables

Visual inspection of outdoor multicore cables indicated that they are in fair condition and could be kept in service until 2048.

## 6.5 Indoor Secondary Systems

Condition assessment of secondary systems, including protection/control panel, equipment, internal components such as links, terminals, wirings, MCBs, fuses, cables is summarized in Appendix A.

### 6.5.1 Indoor Secondary systems panels and cabling

The secondary systems design is based on the standard modular approach where each bay protection panel has its own RTU covering for bay power supplies and control functions (bay AC/DC supplies, CT circuits, controls, indications, alarm). Standard swing frame panels are used, and all VTs and CTs are conventional

units. The protection/control panels are designed to accommodate 19” rack mounted equipment, with all relay equipment being flush mounted. All inter-panel connections are implemented with multi-core cables.

All panels were installed in 2008 with the refurbishment of T065 Alligator Creek substation. This includes the in-service panels:

- +2A1 - 132kV 1 BZ panel
- +2A2 - 132kV 2 BZ panel
- +2A3 - 132kV 3 BZ panel
- +2A4 - 132kV Bay =D52 Cap Bank panel
- +2A5 - 132kV Bay = D53 1-3 Bus Coupler panel
- +2A6 - 132kV Bay =D54 Feeder 7152 panel
- +2A7 - 132kV Bay =D55  3Transformer panel
- +2A8 - 132kV Bay =D56 Feeder 7320 panel
- +2A9 - 132kV Bay =D51 Feeder 7336 panel
- +2A10 - 132kV Power Quality Monitoring panel
- 
- +2B1 - Station panel
- +2B2 - Communications A panel (including the Mux)
- +2B3 - Metering panel
- +2B4 - 132kV Bay = D3 1-2 Bus Coupler panel
- +2B5 - 132kV Bay =D1 Feeder 7319 panel
- +2B6 - 132kV Bay =D4 Feeder 7119 panel
- +2B7 - 132kV Bay =D5 2Transformer panel
- +2B8 - 132kV Bay =D6 Feeder 7175 panel
- +2B9 - 132kV Bay =D2 SVC CB Management panel
- +2B10 - Metering panel 2

Panels and associated cabling are in good condition, consequently condition based replacement has been recommended by 2048. However, screw CT links and terminals shall be upgraded under associated secondary system replacement to mitigate associated safety risks according to SU0049 New physical disconnect terminal for CT circuits.

Typical swing frame protection/control panel

AC lighting servicing secondary system panels should be replaced with DC lighting as part of a major secondary system replacement.

### 6.5.2 Control, Protection, Auxiliary and Ancillary Equipment

Health indices and recommended replacement timeframes for substation secondary system equipment and associated ancillary equipment are tabled in **Appendix A**.

#### 6.5.2.1 132kV switchyard related Bay specific Secondary Systems: Feeders, Bus Bars, Power Transformers, Capacitor Bank

The protection, control, auxiliary and ancillary equipment for Feeders 7319, 7320, 7152, 7119, 7175 and 7336, Bus Zones 1, 2 and 3, Transformers 2 and 3 as well as Capacitor Bank C1 are detailed in the table below.

| Functional Loc. | Description | Manufacturer | Model number | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
|---|---|---|---|---|---|---|---|---|---|
| T065-SSS-7319-BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | [redacted] | 23/04/2008 | Yes | | 27350 | 16 | 7.43 |
| T065-SSS-7319-XPROT | CURR DIFF RELAY ALSTOM P543 + 2ND PORT | AREVA | | 23/04/2008 | Yes | 0 | 26127 | 16 | 7.43 |
| T065-SSS-7319-YPROT | RELAY DISTANCE SEL 311C 1A | SCHWEITZER | | 23/04/2008 | Yes | 16 | 25388 | 16 | 7.43 |
| T065-SSS-7320-BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 28/03/2008 | Yes | 8 | 27350 | 16 | 7.46 |
| T065-SSS-7320-XPROT | CURR DIFF RELAY ALSTOM P543 + 2ND PORT | AREVA | | 28/03/2008 | Yes | 10 | 26127 | 16 | 7.46 |
| T065-SSS-7320-YPROT | RELAY DISTANCE SEL 311C 1A | SCHWEITZER | | 28/03/2008 | Yes | 13 | 25388 | 16 | 7.46 |
| T065-SSS-7152-BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 28/03/2008 | Yes | | 27350 | 16 | 7.46 |
| T065-SSS-7152-PSBLKA | RFL 9745 PROT SIG VF 2 TONE I/O 48-125v | RFL ELECTRONIC | | 28/03/2008 | Yes | 7 | 25542 | 16 | 7.46 |
| T065-SSS-7152-PSBLKB | RFL 9745 PROT SIG VF 2 TONE I/O 48-125v | RFL ELECTRONIC | | 28/03/2008 | Yes | as above | 25542 | 16 | 7.46 |
| T065-SSS-7152-PSDIT | DEWAR DM1200 PROT SIG VF 90-320V SUPPLY | DEWAR | | 28/03/2008 | Yes | 8 | 17266 | 16 | 7.46 |
| T065-SSS-7152-XPROT | RELAY DISTANCE MICOM P442 (WITH R/PORT) | AREVA | | 28/03/2008 | Yes | 9 | 26268 | 16 | 7.46 |
| T065-SSS-7152-YPROT | RELAY DISTANCE SEL 311C 1A | SCHWEITZER | | 13/02/2008 | Yes | 13 | 25388 | 16 | 8.02 |
| T065-SSS-7119-BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 25/08/2008 | Yes | | 27350 | 16 | 7.26 |
| T065-SSS-7119-PSBLKA | RFL 9745 PROT SIG VF 2 TONE I/O 48-125v | RFL ELECTRONIC | | 25/08/2008 | Yes | 7 | 25542 | 16 | 7.26 |
| T065-SSS-7119-PSBLKB | RFL 9745 PROT SIG VF 2 TONE I/O 48-125v | RFL ELECTRONIC | | 25/08/2008 | Yes | as above | 25542 | 16 | 7.26 |
| T065-SSS-7119-PSDIT | DEWAR DM1200 PROT SIG VF 90-320V SUPPLY | DEWAR | | 25/08/2008 | Yes | 8 | 17266 | 16 | 7.26 |
| T065-SSS-7119-XPROT | RELAY CURR DIFF DISTANCE MICOM P546 | SCHNEIDER | | 21/05/2015 | Yes | 14 | 28746 | 09 | 5.18 |
| T065-SSS-7119-YPROT | RELAY DISTANCE SEL 311C 1A | SCHWEITZER | | 25/08/2008 | Yes | 13 | 25388 | 16 | 7.26 |
| T065-SSS-7175-BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 25/08/2008 | Yes | | 27350 | 16 | 7.26 |
| T065-SSS-7175-XPROT | RELAY DISTANCE MICOM P442 (WITH R/PORT) | AREVA | | 25/08/2008 | Yes | 9 | 26268 | 16 | 7.26 |
| T065-SSS-7175-YPROT | RELAY DISTANCE SEL 311C 1A | SCHWEITZER | | 25/08/2008 | Yes | 13 | 25388 | 16 | 7.26 |
| T065-SSS-7336-BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 01/09/2009 | Yes | | 27350 | 15 | 6.83 |
| T065-SSS-7336-XPROT | RELAY CURR DIFF DISTANCE MICOM P546 | AREVA | | 01/09/2009 | Yes | 14 | 28746 | 15 | 6.83 |
| T065-SSS-7336-YPROT | RELAY DISTANCE SEL-421 (1A) (5U) | SCHWEITZER | | 01/09/2009 | Yes | 5 | 26126 | 15 | 6.83 |
| T065-SSS-1BU4-BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 11/04/2008 | Yes | | 27515 | 16 | 7.44 |
| *T065-SSS-1BU4-XPROT | RELAY CB FAIL BUS TRIP RACK | RMS | | 11/04/2008 | Yes | 22 | 26578 | 16 | 7.44 |
| *T065-SSS-1BU4-XPROT | RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC | AREVA | | 11/04/2008 | Yes | 9 | 13754 | 16 | 7.44 |
| *T065-SSS-1BU4-XPROT | RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13 | AREVA | | 11/04/2008 | Yes | 11 | 26689 | 16 | 7.44 |
| *T065-SSS-1BU4-XPROT | RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12 | AREVA | | 11/04/2008 | Yes | 6 | 26690 | 16 | 7.44 |
| *T065-SSS-1BU4-YPROT | RELAY CB FAIL BUS TRIP RACK | RMS | | 11/04/2008 | Yes | 22 | 26578 | 16 | 7.44 |
| *T065-SSS-1BU4-YPROT | RELAY DIFF AREVA MFAC34 RANGE: 25-325VAC | AREVA | | 11/04/2008 | Yes | 9 | 13754 | 16 | 7.44 |
| *T065-SSS-1BU4-YPROT | RELAY TRIPPING LOW BURDEN ALSTOM MVAJ13 | AREVA | | 11/04/2008 | Yes | 11 | 26689 | 16 | 7.44 |

| Functional Loc. | Description | Manufacturer | Model number | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
|---|---|---|---|---|---|---|---|---|---|
| *T065-SSS-1BU4-YPROT | RELAY TRIPPING SUPPLY FAIL ALSTOM MVAX12 | AREVA | [redacted] | 11/04/2008 | Yes | 6 | 26690 | 16 | 7.44 |
| | | | | | | | | | |
| ***NOTE** | *** Bus Zones 2 and 3 panels have identical Secondary Systems devices to Bus Zone 1** | | | | | | | | |
| | | | | | | | | | |
| T065-SSS-2TRF-CONTSYS | TRANSF 2 OLTC CONTROL | CONTSYS | | 01/07/1982 | Yes | | | 42 | 9.5 |
| T065-SSS-442--BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 14/11/2008 | Yes | | 27350 | 16 | 7.15 |
| T065-SSS-442--XPROT | RELAY POWER SUPPLY MODULE GE UR RH | GE | | 14/11/2008 | Yes | | | 16 | 9.53 |
| T065-SSS-442--XPROT | RELAY TRANSF DIFF GE T60 (2.93) | GE | | 14/11/2008 | Yes | 2 | 27193 | 16 | 7.15 |
| T065-SSS-442--YPROT | RELAY BIASED DIFF SEL-387-5 (1A) (3U) | SCHWEITZER | | 14/11/2008 | Yes | 2 | 25465 | 16 | 7.15 |
| T065-SSS-3TRF-CONTSYS | TRANSF 3 OLTC CONTROL | CONTSYS | | 28/02/2008 | Yes | | | 16 | 7.5 |
| T065-SSS-442--BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 28/03/2008 | Yes | | 27350 | 16 | 7.46 |
| T065-SSS-443--XPROT | RELAY POWER SUPPLY MODULE GE UR RH | GE | | 23/05/2008 | Yes | | | 16 | 9.85 |
| T065-SSS-443--XPROT | RELAY TRANSF DIFF GE T60 (2.93) | GE | | 28/03/2008 | Yes | 2 | 27193 | 16 | 7.46 |
| T065-SSS-443--YPROT | RELAY BIASED DIFF SEL-387-5 (1A) (3U) | SCHWEITZER | | 28/03/2008 | Yes | 2 | 25465 | 16 | 7.46 |
| T065-SSS-482--BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 1/07/2009 | Yes | | 27350 | 15 | 6.83 |
| T065-SSS-482--XPROT | RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE) | GE | | 1/07/2009 | Yes | 8 | 26931 | 15 | 6.83 |
| T065-SSS-482--XPROT | RELAY POWER SUPPLY MODULE GE UR RH | GE | | 1/07/2009 | Yes | | | 15 | 9.11 |
| T065-SSS-482--YPROT | RELAY CB MGMT SEL-451 1A, 125VDC | SCHWEITZER | | 1/07/2009 | Yes | 7 | 28752 | 15 | 6.83 |
| T065-SSS-481--BAYCONT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 11/04/2008 | Yes | | 27350 | 16 | 7.44 |
| T065-SSS-481--POWAVE | RELAY POINT ON WAVE ABB E213 | ABB | | 11/04/2008 | Yes | 1 | 25640 | 16 | 7.44 |
| T065-SSS-481--XPROT | RELAY CAP PROTN ABB SPAJ160C | ABB | | 11/04/2008 | Yes | | 15980 | 16 | 7.44 |
| T065-SSS-481--XPROT | RELAY CB MGMT GE C60 (VER 2.93 FIRMWARE) | GE | | 11/04/2008 | Yes | 8 | 26931 | 16 | 7.44 |
| T065-SSS-481--XPROT | RELAY OC & EF ABB SPAJ140C | ABB | | 11/04/2008 | Yes | 2 | 12182 | 16 | 7.44 |
| T065-SSS-481--XPROT | RELAY POWER SUPPLY MODULE GE UR RH | GE | | 11/04/2008 | Yes | | | 16 | 9.92 |
| T065-SSS-481--YPROT | RELAY CBMAN SEL-351-1 (1A) | SCHWEITZER | | 11/04/2008 | Yes | 8 | 25466 | 16 | 7.44 |

The majority of secondary systems equipment in the building were commissioned in 2008 and are now obsolete. The health indices show that these assets will reach the end of technical life and require replacement by 2028. Foxboro [redacted] range of RTUs are discontinued products and technical support for them has ended.

### 6.5.2.2 SVC related Secondary Systems

The protection, control, auxiliary and ancillary equipment for the SVC are detailed in the table below.

| Functional Loc. | Description | Manufacturer | Model number | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
|---|---|---|---|---|---|---|---|---|---|
| T065-SSS-2SVC-3HFXPROT | RELAY CAPACITOR/FILTER TRENCH CPR04 | TRENCH | [redacted] | 31/07/2009 | No | 0 | 29840 | 14.5 | 6.79 |
| T065-SSS-2SVC-3HFXPROT | RELAY CAPACITOR/FILTER TRENCH CPR04 | TRENCH | | 31/07/2009 | No | 0 | 29840 | 14.5 | 6.79 |
| T065-SSS-2SVC-3HFYPROT | RELAY MULTIFUNCTION DIFF SIEMENS 7SJ61 | SIEMENS | | 31/07/2009 | Yes | 0 | 31288 | 14.5 | 6.79 |
| T065-SSS-2SVC-5HFXPROT | RELAY CAPACITOR/FILTER TRENCH CPR04 | TRENCH | | 31/07/2009 | Yes | 0 | 29840 | 14.5 | 6.79 |
| T065-SSS-2SVC-5HFYPROT | RELAY MULTIFUNCTION DIFF SIEMENS 7SJ61 | SIEMENS | | 31/07/2009 | Yes | 0 | 31288 | 14.5 | 6.79 |
| T065-SSS-2SVC-BICOOL | INTERFACE MODULE (SU200:1) | SIEMENS | | 31/07/2009 | Yes | 1 | 31647 | 14.5 | 6.79 |

| Functional Loc. | Description | Manufacturer | Model number | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
|---|---|---|---|---|---|---|---|---|---|
| T065-SSS-2SVC-BICTRLAN | INTERFACE MODULE (SU200:12) | SIEMENS | [redacted] | 31/07/2009 | Yes | 3 | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BICTRLAN | INTERFACE MODULE (SU200:13) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BIPROT | INTERFACE MODULE (SU200:3) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BIPROT | INTERFACE MODULE (SU200:4) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BIPROT | INTERFACE MODULE (SU200:5) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BISTN | INTERFACE MODULE (SU200:14) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BISYARD | INTERFACE MODULE (SU200:16) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BISYARD | INTERFACE MODULE (SU200:17) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BISYARD | INTERFACE MODULE (SU200:8) | SIEMENS | | 31/07/2009 | Yes | as above | 31646 | 14.5 | 6.79 |
| T065-SSS-2SVC-BUSXPROT | RELAY MULTIFUNCTION DIFF SIEMENS 7SJ62 | SIEMENS | | 31/07/2009 | Yes | 1 | 31289 | 14.5 | 6.79 |
| T065-SSS-2SVC-BUSYPROT | RELAY MULTIFUNCTION DIFF SIEMENS 7SJ62 | SIEMENS | | 31/07/2009 | Yes | as above | 31289 | 14.5 | 6.79 |
| T065-SSS-2SVC-CONTSYS | CLOSED LOOP CONTROL UNIT | SIEMENS | | 31/07/2009 | Yes | 0 | 31543 | 14.5 | 8.11 |
| T065-SSS-2SVC-DATCONV | DATA CONVERTER COMPUTER | IPCOMM | | 31/07/2009 | Yes | 0 | 31630 | 14.5 | 9.5 |
| T065-SSS-2SVC-DISTREC | TRANSIENT FAULT RECORDER (=X2+SB2-A4) | IBA | | 31/07/2009 | Yes | 0 | 31618 | 14.5 | 6.79 |
| T065-SSS-2SVC-DISTREC | TRANSIENT FAULT RECORDER (=X2+SB2-A5) | IBA | | 31/07/2009 | Yes | 0 | 31618 | 14.5 | 6.79 |
| T065-SSS-2SVC-DISTREC | TRANSIENT FAULT RECORDER (=X2+SB2-A6) | IBA | | 31/07/2009 | Yes | 0 | 31618 | 14.5 | 6.79 |
| T065-SSS-2SVC-EMVI | ELECTRONIC CURRENT TRANSDUCER RECEIVER | RITZ | | 31/07/2009 | Yes | 1 | 31607 | 14.5 | 6.79 |
| T065-SSS-2SVC-EMVI | ELECTRONIC CURRENT TRANSDUCER RECEIVER | RITZ | | 31/07/2009 | Yes | as above | 31607 | 14.5 | 6.79 |
| T065-SSS-2SVC-EMVI | ELECTRONIC CURRENT TRANSDUCER RECEIVER | RITZ | | 31/07/2009 | Yes | as above | 31607 | 14.5 | 6.79 |
| T065-SSS-2SVC-HMI | HMI COMPUTER | SIEMENS | | 31/07/2009 | Yes | 8 | 29902 | 14.5 | 13.58 |
| T065-SSS-2SVC-HMI | MONITOR | FUJITSU SIEMENS | | 31/07/2009 | Yes | 1 | 34314 | 14.5 | 6.79 |
| T065-SSS-2SVC-OWCOVERT | DC/DC CONVERTER | PHOENIX | | 31/07/2009 | No | 1 | 27643 | 14.5 | 6.79 |
| T065-SSS-2SVC-OWINVERT | INVERTER 125VDC/240VAC 1800W | LATRONICS | | 31/07/2009 | Yes | 5 | 25941 | 14.5 | 6.79 |
| T065-SSS-2SVC-OWNTWK | SWITCH (=X1+SB1-A5) | RUGGEDCOM | | 31/07/2009 | Yes | 2 | 29868 | 14.5 | 9.5 |
| T065-SSS-2SVC-OWPRINT | PRINTER | HEWLETT PACKARD | | 31/07/2009 | Yes | | 26840 | 14.5 | 6.79 |
| T065-SSS-2SVC-OWPSA | CHECK POINT 1200R IPS RUGGED APPLIANCE | CHECKPOINT | | 4/03/2019 | No | | 39989 | 5 | 2 |
| T065-SSS-2SVC-RTU | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 31/07/2009 | Yes | 17 | 27353 | 14.5 | 6.79 |
| T065-SSS-2SVC-SERVPC | SERVICE COMPUTER | SIEMENS | | 31/07/2009 | Yes | 8 | 29902 | 14.5 | 9.6 |
| T065-SSS-2SVC-SVCNTWK | SWITCH (=X1+SB1-A3) | RUGGEDCOM | | 31/07/2009 | Yes | 2 | 29868 | 14.5 | 9.6 |
| T065-SSS-2SVC-TCR1VBE | VALVE CONTROL UNIT (VBE) | SIEMENS | | 31/07/2009 | Yes | 4 | 29930 | 14.5 | 6.79 |
| T065-SSS-2SVC-TCR1XPRO | RELAY MULTIFUNCTION DIFF SIEMENS 7UT612 | SIEMENS | | 31/07/2009 | Yes | 0 | 31290 | 14.5 | 6.79 |
| T065-SSS-2SVC-TCR1YPRO | RELAY MULTIFUNCTION DIFF SIEMENS 7SJ61 | SIEMENS | | 31/07/2009 | Yes | 0 | 31288 | 14.5 | 6.79 |
| T065-SSS-2SVC-TIMING | GPS CLOCK | SIEMENS | | 31/07/2009 | Yes | 0 | 29871 | 14.5 | 6.79 |
| T065-SSS-2SVC-TRFXPROT | RELAY MULTIFUNCTION DIFF SIEMENS 7UT635 | SIEMENS | | 31/07/2009 | Yes | 0 | 31291 | 14.5 | 6.79 |
| T065-SSS-2SVC-TRFYPROT | RELAY MULTIFUNCTION DIFF SIEMENS 7UT635 | SIEMENS | | 31/07/2009 | Yes | As above | 31291 | 14.5 | 6.79 |
| T065-SSS-2SVC-TSC1VBE | VALVE CONTROL UNIT (VBE) | SIEMENS | | 31/07/2009 | Yes | 4 | 29930 | 14.5 | 6.79 |
| T065-SSS-2SVC-TSC1XPRO | RELAY CAPACITOR/FILTER TRENCH CPR04 | TRENCH | | 31/07/2009 | Yes | 0 | 29840 | 14.5 | 6.79 |
| T065-SSS-2SVC-TSC1XPRO | RELAY MULTIFUNCTION DIFF SIEMENS 7UT612 | SIEMENS | | 31/07/2009 | Yes | 0 | 31290 | 14.5 | 6.79 |
| T065-SSS-2SVC-TSC1YPRO | RELAY MULTIFUNCTION DIFF SIEMENS 7SJ61 | SIEMENS | | 31/07/2009 | Yes | 0 | 31288 | 16 | 7.26 |
| T065-SSS-2SVC-VCOOLCON | SVC COOLING WATER SYSTEM | GUNTNER | | 31/07/2009 | Yes | | | 16 | 7.26 |

## 6.6 Revenue Metering Equipment

There is a total of 6 MNIs allocated: one for each of the following metering points:

- Metering panel 1 (+2B3) catering for Feeders 7319, 7320, 7336 and the SVC bay (this arrangement shall be reviewed during the next Secondary Systems refurbishment). The three feeders' metering is consistent with the TNCP (Transmission Network Connection Point) Connection and Access Agreement between Powerlink Queensland and Energy Queensland.

- Metering panel 2 (+2B10) catering for 2T and 3T with both transformers currently utilising CT and VT signals from the Energy Queensland 33kV side. This shall be reviewed during the next Secondary Systems refurbishment, so that such signals will be from the transformers' HV side.

T065 Alligator Creek Substation metering equipment detailed in the table below was installed in 2008.

| Functional Loc. | Description | Manufacturer | Model number | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
|---|---|---|---|---|---|---|---|---|---|
| T065-SSS-METR-2TRFCHK | ENERGY METER (CHECK) +2B10 | SCHWEITZER | [redacted] | 5/04/2022 | No | | 42268 | 2 | 4.23 |
| T065-SSS-METR-2TRFREV | ENERGY METER (REVENUE) +2B10 | SCHWEITZER | | 4/04/2022 | No | | 42268 | 2 | 4.23 |
| T065-SSS-METR-3TRFCHK | ENERGY METER (CHECK) +2B10 | SCHWEITZER | | 30/03/2022 | No | | 42268 | 2 | 4.23 |
| T065-SSS-METR-3TRFREV | ENERGY METER (REVENUE) +2B10 | SCHWEITZER | | 31/03/2022 | No | | 42268 | 2 | 4.23 |
| T065-SSS-METR-REVMET4 | METER KWH/KVARH EDMI | EDMI | | 27/11/2009 | Yes | 5 | 15879 | 15 | 6.63 |
| T065-SSS-METR-REVMET4 | METER KWH/KVARH EDMI | EDMI | | 27/11/2009 | Yes | 5 | 15879 | 15 | 6.63 |
| T065-SSS-METR-REVMET5 | METER KWH/KVARH EDMI | EDMI | | 27/11/2009 | Yes | 5 | 15879 | 15 | 6.63 |
| T065-SSS-METR-REVMET5 | METER KWH/KVARH EDMI 2000-0400 CL 0.5 | EDMI | | 27/11/2009 | Yes | 5 | 15879 | 15 | 6.63 |
| T065-SSS-METR-REVMET6 | KWH/KVARH EDMI 2000-0400 CL 0.5 (CHECK) | EDMI | | 1/07/2009 | Yes | 5 | 15879 | 15 | 6.83 |
| T065-SSS-METR-REVMET6 | KWH/KVARH EDMI 2000-0400 CL 0.5 (REV) | EDMI | | 1/07/2009 | Yes | 5 | 15879 | 15 | 6.83 |
| T065-SSS-METR-REVMET7 | KWH/KVARH EDMI 2000-0400 CL 0.5 (REV) | EDMI | | 31/07/2009 | Yes | 5 | 15879 | 15 | 6.79 |
| T065-SSS-METR-REVMET7 | METER KWH/KVARH EDMI 2000-0400 CL 0.5 | EDMI | | 31/07/2009 | Yes | 5 | 15879 | 15 | 6.79 |

The risk of revenue meter failure affecting the transmission network is considered to be moderate. The older EDMI metering equipment in +2B3 (Feeders 7319, 7320, 7336, SVC) can be kept in service until 2028, and are recommended to be replaced as part of the secondary system replacement project by 2028. The newer metering equipment in +2B10 (2T, 3T) can be kept in service until 2042.

Metering panels +2B3 (left) and +2B10 (right)

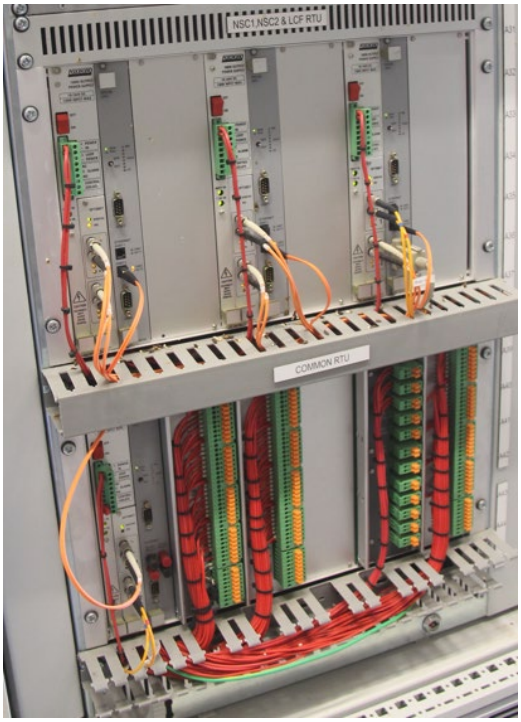
## 6.7 SCADA and Automation

The NSC1 and NSC2 are identical C50 RTUs providing the interface between the substation control system and the Network Switching Centre (NSC) at Virginia. The dual RTUs arrangement provide fully redundant communication paths between the substation and NSC. They are used for communicating measurements, indications and alarms from the substation as well as for substation remote control from Virginia. The RTUs communicate to the NSC using DNP3 protocol via serial ports.

This equipment should be replaced as part of the secondary systems replacement project i.e. by 2028.

The HMI interface in each substation building, responsible for local control and monitoring of the secondary system, event connection, and remote access to the HMI system via OpsWAN, should be updated during any project work to show the correct operational state.

| Functional Loc. | Description | Manufacturer | [redacted] | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
|---|---|---|---|---|---|---|---|---|---|
| T065-SSS-NBAY-INVERT1 | INVERTER 48VDC/240VAC 1800W | LATRONICS | | 1/07/2009 | Yes | 2 | 25938 | 15 | 6.83 |
| T065-SSS-NBAY-LCFINT | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 27/10/2004 | Yes | 0 | 26044 | 20 | 9.17 |
| T065-SSS-NBAY-LCFINT2 | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 28/03/2008 | Yes | 0 | 26044 | 15 | 7.46 |
| T065-SSS-NBAY-NSCLNK12 | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 9/09/2004 | Yes | 0 | 26044 | 20 | 9.24 |
| T065-SSS-NBAY-NSCLNK22 | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 28/03/2008 | Yes | 0 | 26044 | 16 | 7.46 |
| T065-SSS-NBAY-OWSERV | MONITOR/KEYBOARD | ICP GLOBAL | | 1/07/2009 | Yes | 0 | 27630 | 15 | 6.83 |
| T065-SSS-NBAY-RTUCOM1 | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 1/07/2009 | Yes | 1 | 27352 | 15 | 6.83 |
| T065-SSS-NBAY-RTUCOM2 | REMOTE TERMINAL UNIT FOXBORO C50 | FOXBORO | | 28/03/2008 | Yes | 1 | 27352 | 16 | 7.46 |
| T065-SSS-NBAY-RTUNPS | REMOTE TERMINAL UNIT FOXBORO C50 SPECIAL | FOXBORO | | 27/06/2007 | Yes | 0 | | 17 | 7.84 |
| | | | | | | | | | |




NSC1/NSC2/LCF and common RTU in building +2

[redacted]

## 6.8 Power System Monitoring

### 6.8.1 High Speed Monitoring and Power Quality Monitoring

Power Quality Monitoring (PQM) has been installed in building +2 panel +2A10.

| Functional Loc. | Description | Manufacturer | Model number | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| T065-SSS-NBAY-PWRQUAL1 | PQ ANALYSER UNIPOWER T065PQOA | UNIPOWER | [redacted] | 5/06/2013 | No | 0 | 33423 | 11 | 6.71 |
| T065-SSS-NBAY-PWRQUAL2 | PQ ANALYSER UNIPOWER T065PQOB | UNIPOWER | | 27/07/2016 | No | 3 | 37441 | 18 | 8.3 |
| | | | | | | | | | |

### 6.8.2 WAMPAC – Wide Area Monitoring Protection And Control

WAMPAC scheme across the network has been utilised to maintain the system stability by shedding load blocks. Load blocks at T065 Alligator Creek would not be potentially required for WAMPAC schemes. As such, no WAMPAC is required at this stage at T065 Alligator Creek substation.

## 6.9 Integrated Operation and Network Service (IONS, former OpsWAN)

IONS, former OpsWAN systems and equipment at this site were installed in 2007 as detailed in a table below.

| Functional Loc. | Description | Manufacturer | Model number | Start-up date | Obsolescence (Yes / No) | Spare Qty | Material | Eff. Age | HI |
|---|---|---|---|---|---|---|---|---|---|
| T065-SSS-IONS-HDWR | AXIS ETHERNET CAMERA ASSEMBLY T065WCOA | Take a Look | [redacted] | 1/03/2019 | No | 14 | 33869 | 5 | 6.52 |
| T065-SSS-IONS-NTWK2 | FIREWALL 1 | CHECKPOINT | | 12/08/2020 | No | 1 | 39989 | 4 | 1.27 |
| T065-SSS-IONS-NTWK2 | FIREWALL 2 | CHECKPOINT | | 12/08/2020 | No | 1 | 39989 | 4 | 1.27 |
| T065-SSS-IONS-NTWK2 | METER A ROUTER +2B10 | CISCO | | 7/04/2022 | No | 4 | 42182 | 2 | 0.45 |
| T065-SSS-IONS-NTWK2 | METER A SWITCH +2B10 | CISCO | | 7/04/2022 | No | 21 | 40228 | 2 | 1.53 |
| T065-SSS-IONS-NTWK2 | METER A SWITCH +2B3 | CISCO | | 7/04/2022 | No | 34 | 39260 | 2 | 0.45 |
| T065-SSS-IONS-NTWK2 | METER B ROUTER +2B10 | CISCO | | 7/04/2022 | No | 4 | 42182 | 2 | 0.45 |
| T065-SSS-IONS-NTWK2 | METER B SWITCH +2B10 | CISCO | | 7/04/2022 | No | 21 (as above) | 40228 | 2 | 1.53 |
| T065-SSS-IONS-NTWK2 | METER B SWITCH +2B3 | CISCO | | 7/04/2022 | No | 34 (as above) | 39260 | 2 | 0.45 |
| T065-SSS-NBAY-OWCAM2 | AXIS ETHERNET CAMERA ASSEMBLY T065WCOB | Take a Look | | 10/12/2019 | No | 14 | 33869 | 5 | 1.61 |
| T065-SSS-NBAY-OWCAM3 | AXIS ETHERNET CAMERA ASSEMBLY T065WCOC | Take a Look | | 28/11/2019 | No | As above | 33869 | 5 | 6.52 |
| T065-SSS-NBAY-OWNTWK1 | ROUTER [redacted] OPSWAN | CISCO | | 1/07/2009 | Yes | 3 | 27651 | 15 | 6.83 |
| T065-SSS-NBAY-OWNTWK1 | SWITCH ETHERNET 3 x 8 PORT | ALLOY | | 1/07/2009 | Yes | 5 | 27632 | 15 | 6.83 |
| T065-SSS-NBAY-OWNTWK2 | SERVER SERIAL PORT | PERLE | | 28/03/2008 | Yes | 6 | 27733 | 16 | 7.46 |
| T065-SSS-NBAY-OWNTWK2 | SWITCH 8PORT | RUGGEDCOM | | 28/03/2008 | No | 16 | 27400 | 16 | 7.46 |
| T065-SSS-NBAY-OWSERV | TERMINAL SERVER | ICP ELECTRONICS | | 1/07/2009 | Yes | 5 | 27636 | 15 | 6.38 |
| | | | | | | | | | |

IONS/OpsWAN systems have an important role in operation and maintenance.

Indoor IONS/OpsWAN systems in buildings +1 and +2 are recommended to be replaced as part of the secondary systems replacement project i.e. by 2028.

OpsWAN Cubicle +1.2.3.3

The three OpsWAN cameras (outdoor OpsWAN equipment), two of which were installed in 2009, shall be replaced under a secondary system refurbishment project by 2028. This shall include relocating all related devices from the OpsWAN camera housing at the top of the pole to the camera patch box at the base of the pole according to the ETR 10434041 OpsWAN Camera Lowering Device Trial – Task Report (Objective ID: A4982111).

OpsWAN camera

## 6.10 Auxiliary Supply

### 6.10.1 AC Auxiliary Supply

Two 3 x phase 400kVA Station Transformers 132kV/400V installed in 2008 provide the LV AC supplies via a changeover board.

There is no permanent diesel generator, yet the existing changeover board has a connection available for such generator

A stand-alone emergency generator plug-in box (+U-A22, refer H-153095-002) located outside building +1 entrance, allows the connection of a mobile generator to power-up specific critical loads.

This arrangement complies with the current Powerlink substation AC supply specification.

One of the two station transformers shown above

The outdoor main AC changeover board manufactured in 2007 and installed in 2008 is located near building +1. As part of the Secondary Systems refurbishment, this board shall be assessed for compliance with the current AS/NZS 3000 Wiring Rules, current Powerlink design standards and applicable Standard Updates (including Arc Flash risk and labelling). Once compliance assessed, this board would remain in operation until 2048.

Main AC changeover board +U-A01

The AC distribution board in the building +1 has been installed in 1982 with the building (ref. N_408505-001). Consideration shall be given to upgrading the board.

The AC distribution board in the demountable building +2 installed in 2008 is in good condition. Similar to the AC change over board, as part of the Secondary Systems refurbishment, this board shall be assessed for compliance with the current AS/NZS 3000 Wiring Rules, current Powerlink design standards and applicable Standard Updates (including Arc Flash risk and labelling). Once compliance assessed, this board would remain in operation until 2048.

Building +2  400VAC distribution board +2C10

The AC distribution board in the SVC building +3 installed in 2009 is in good condition. As part of an SVC Secondary Systems refurbishment, this board shall be assessed for compliance with the current AS/NZS 3000 Wiring Rules, current Powerlink design standards and applicable Standard Updates (including Arc Flash risk and labelling). Once compliance assessed, this board would remain in operation until 2049.

SVC Building +3  400VAC distribution board DB-NE2+SN23

### 6.10.2 DC Systems

T065 Alligator Creek substation includes several DC Systems as described below.

Building +1 single (X) 125V DC rectifier was installed in 2003, it is past its design life and shall be replaced as a matter of priority. Its battery bank installed in January 2013 will approach its end of design life soon and shall be replaced by 2028.

Building +1 dual (A and B) 50V DC system: The A rectifier was installed in 2003, B rectifier in 2008 shall both be replaced by 2028. Its dual A/B battery bank installed in January 2017 shall be replaced by 2031

Building +2 dual (X and Y) 125V DC system rectifiers were installed in 2008 with building +2 and shall be replaced by 2028. Its dual X/Y battery bank installed in January 2017 shall be replaced by 2031.

Note for information only: 50V DC dual supplies in building +2 are provided via 125V DC / 50V DC converters.


Building +2 125VDC battery banks and chargers

SVC Building +3 dual (X and Y) 125V DC system rectifiers were installed in 2009 with the SVC and shall be replaced by 2029. Its dual X/Y battery bank installed in January 2019 shall be replaced by 2034.

# 7 Foreseeable Primary Plant Replacement Plan

Apart from selective primary plant replacement in bays D05 and D06 (under CP.02800 – yet to be approved in February 2024) there is no foreseeable other primary plant replacement planned at T065 Alligator Creek in the next 10 years.

# 8 Conclusion

This report details the condition of T065 Alligator Creek substation secondary systems and equipment. The primary objective of the optimal replacement timeframe is to ensure the network reliability and availability and to minimise operational and compliance risks associated with secondary systems assets.

Based on the condition assessment, the main recommendations for the replacement of secondary systems equipment at T065 Alligator Creek are:

**Stage 1 - Conduct the following 132kV Switchyard related secondary system replacements by 2028:**

- Implement SU0049 throughout the Secondary Systems at site;
- Replace CT links and terminals of all marshalling cubicles;
- Replace the protection and control equipment and associated CT links/terminals in relation to 132kV Feeders 7319, 7320, 7152, 7119, 7175 and 7336;
- Replace the protection and control equipment and associated CT links/terminals in relation to 132kV Bus Couplers 4112 and 4122
- Replace the protection and control equipment and associated CT links/terminals in relation to 132kV Transformers 2T and 3T
- Replace the protection and control equipment and associated CT links/terminals in relation to 132kV 1CAP
- Replace the protection and control equipment and associated CT links/terminals in relation to 132kV 4822 connection bay to the SVC

- Replace 132kV revenue metering equipment and associated CT links and terminals according to current standard; On 2T and 3T revenue metering, consider utilising CT/VT sources from the transformers' HV side;
- Replace all C50 RTUs associated with OptoNet ring including NSC1, NSC2, LCF RTU and common RTU;
- Replace the timing system;
- Replace HMI Sun Workstation;
- Upgrade SCADA DNP serial to DNP over TCP/IP;
- Replace all IONS (OpsWAN) equipment and relocate all devices (except the camera) from the OpsWAN camera housing at the top of the pole to the camera patch box at the base of the pole;
- Review and replace CT Links as necessary in the PQM panel
- Change the indoor Secondary Systems panels lighting from AC to DC as per the current Powerlink standard;
- Review the suitability (capacity) of the LV AC supplies;
- Review the AC Supply enclosures and ensure Arc Flash compliance;
- Upgrade the AC board in building +1;
- Consider removing the +1 single 125V DC or transfer it to Energy Queensland to support their secondary systems;
- Replace the +1 dual A/B 50V DC chargers and associated monitoring system
- Replace the +2 dual X/Y 125V DC chargers and associated monitoring system

**Stage 2 – Carry out replacement on the SVC control system by 2029:**

- Implement SU0049 throughout the SVC Secondary Systems at site;
- Replace CT links and terminals of all marshalling kiosks;
- Replace the protection and control equipment and associated CT links/terminals in relation to the SVC, including the TDC and SVC cooling control system;
- Replace the timing system as applicable;
- Replace [redacted];
- Upgrade SCADA DNP serial to DNP over TCP/IP;
- Change the indoor Secondary Systems panels lighting from AC to DC as per the current Powerlink standard;
- Review the AC Supply enclosures and ensure Arc Flash compliance;
- Upgrade the SVC AC Changeover System and the AC distribution board in the SVC building +3;
- Replace the +3 dual X/Y 125V DC chargers and monitoring system,

**Stage 3 - Conduct the following replacements by 2031:**

- Replace the 50V DC A and B battery banks in building +1
- Replace the 125V DC X and Y battery banks in building +2

**Stage 4 - Conduct the following SVC System related equipment replacements by 2034:**

- Replace the 125V DC X and Y battery banks in the SVC building +3 by 2034

# 9 Appendix A

T065 Alligator Creek v2.0 Appendix

# 10 Distribution List

| Divisional Distribution | Contact details |
| --- | --- |
| Chief Executive | N/A |
| Delivery and Technical Solutions | Manger Secondary System Design<br>Team Leader Commissioning |
| Finance and Governance | N/A |
| Network and Business Development | Manager Asset Strategies |
| Operations and Service Delivery | Team Leader Secondary System Support |
| People and Corporate Services | N/A |

| Planning Report | 30 May 2025 |
|---|---|
| Title | CP.02800 Alligator Creek Substation Reinvestment |
| Zone | North |
| Need Driver | Emerging critical issues with 132kV bays arising from condition and obsolescence of Alligator Creek's ageing primary and secondary systems. |
| Network Limitations and statutory requirements | Alligator Creek Substation is required to meet Powerlink Queensland's N-1-50MW/600MWh Transmission Authority reliability standard. |
| Pre-requisites | None |

## Executive Summary

Ageing and obsolete primary and secondary systems at Alligator 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[1].

Energy Queensland and Aurizon forecasts confirm there is an enduring need to maintain electricity supply into the Alligator Creek area. The removal or reconfiguration of the Alligator Creek 132/33kV Substation due to secondary system failure or primary plant 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 the replacement of the at-risk primary plant and secondary systems.

[1] 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

T065 Alligator Creek substation was established in the early 1980s. It is a 132/33kV bulk supply point for the southern Mackay region providing supply to the Aurizon Oonooie and Mackay Ports connections, the Hay Point and Dalrymple Bay coal loading terminals and surrounding communities via the Ergon Energy network.

Figure 1 shows the geographic location of the Alligator Substation within the North Queensland zone.

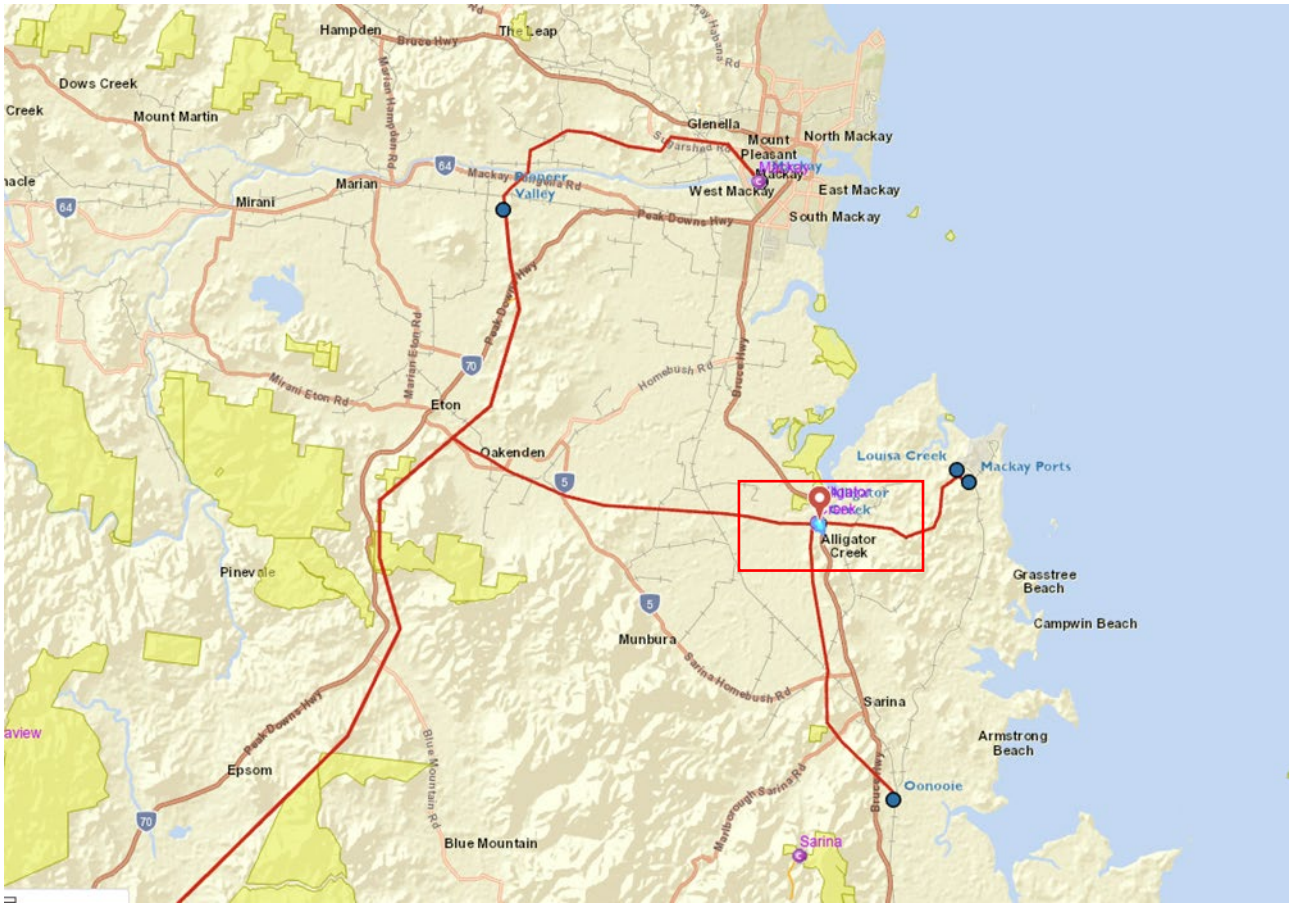



Figure 1. Alligator Creek Substation location

Primary plant from the original substation establishment is aged over 40 years and the Condition Assessment [1] indicates emerging critical issues with equipment in the132kV bays. Similarly, the condition assessment of the secondary systems [2] identified that the protection and control devices for the 132kV bays will reach the end of their technical asset life in 2028.

In addition to the site-specific impacts of obsolescence at Alligator Creek 132kV 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 report assesses the impact that removal of the at-risk systems would have on the performance of the network and Powerlink's statutory obligations. It also establishes the indicative requirements of any potential alternative solutions to the current services provided by Alligator Creek Substation.

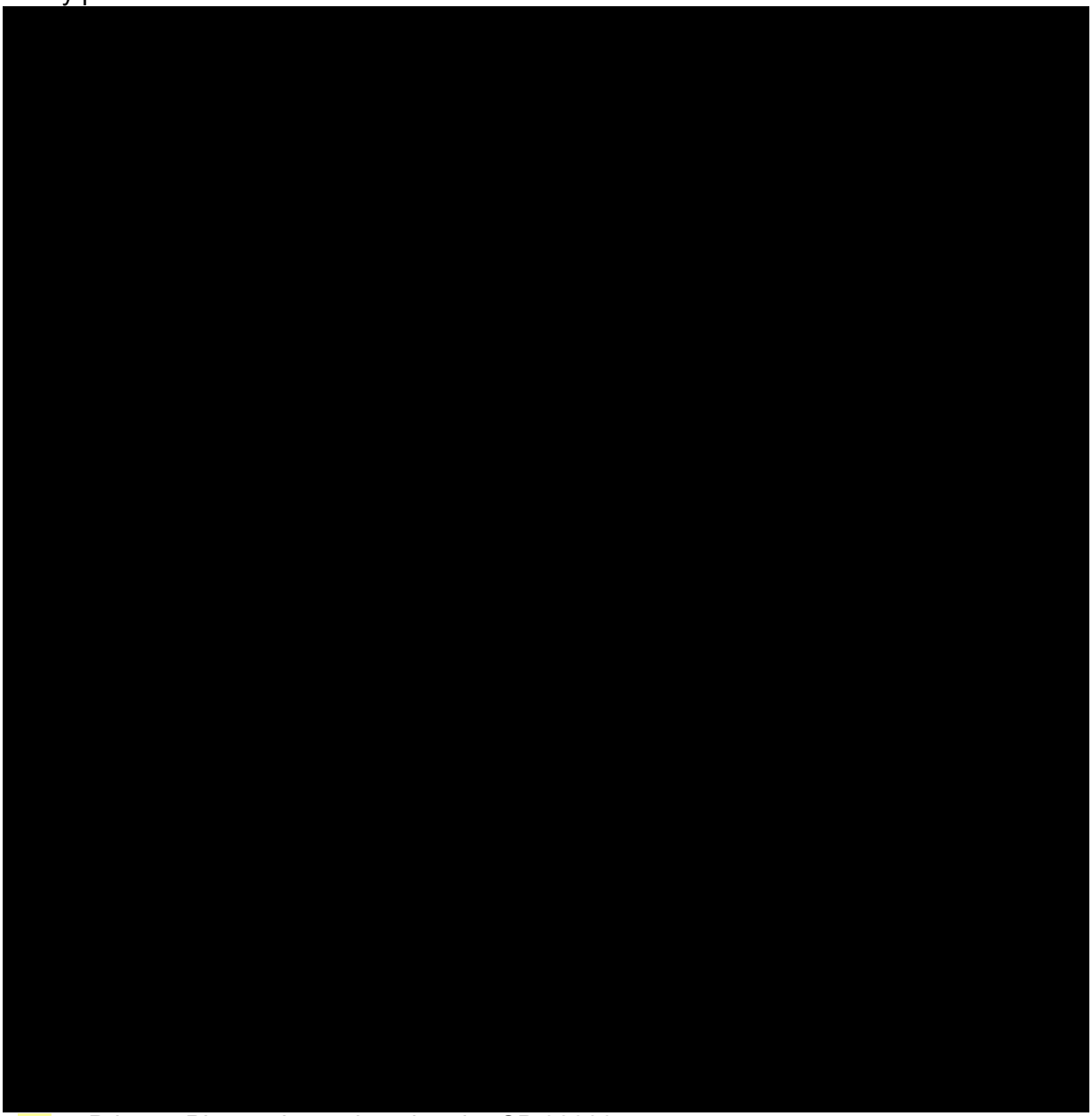
## 2. Alligator Creek Substation configuration

The Alligator Creek Substation consists of:

1. A 132kV switchyard which provides 2 x 132/33kV transformer bays, 2 x 132kV feeders for Aurizon loads Mackay Ports and Oonooie, and 2 x 132/33kV transformer ended feeders for Ergon, and

2. Two 132/33kV feeders from Pioneer Valley and Nebo Substations.

Figure 2 shows the existing connection configuration of the Alligator Creek Substation and primary plant at-risk.



Primary Plant to be replaced under CP.02800

Figure 2. Alligator Creek 132/33kV Substation Line Dagram

The scope of the at-risk secondary system equipment is outlined in the Project Scope Report [3], but in summary encompasses all feeder, coupler and reactive plant bays together with bus sections.

## 3. Alligator Creek Demand Forecast

Figure 3 shows that the historical and maximum demand forecasts for the loads supplied from the Alligator Creek Substation. The loads are expected to gradually increase in coming years.

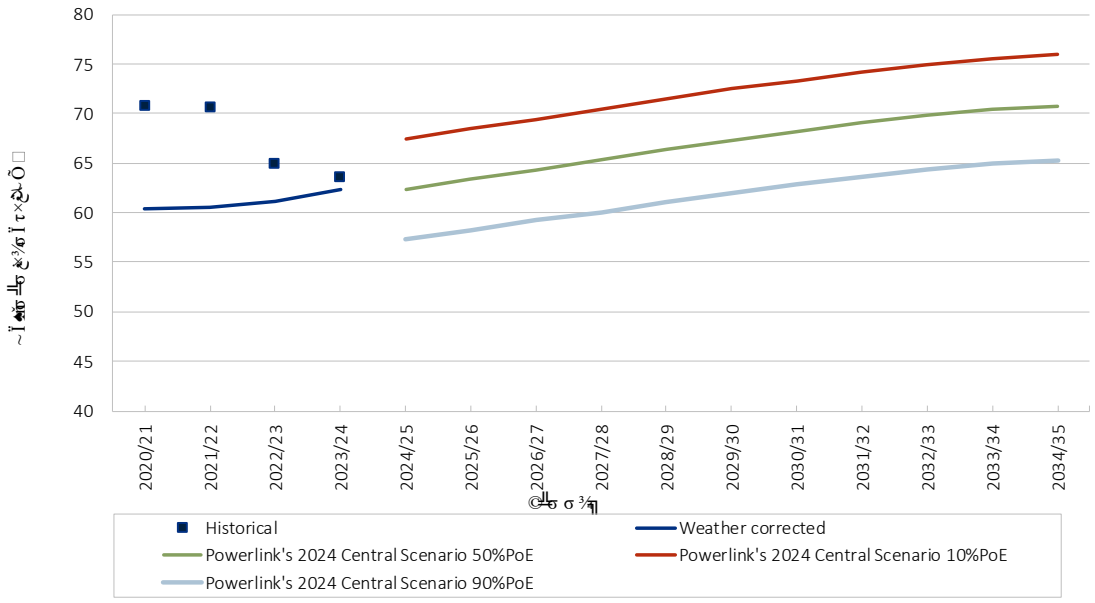



Figure 3. Alligator Creek 110kV Maximum Demand

Figure 4 is the duration curve for the loads connected to Alligator Creek 132kV.

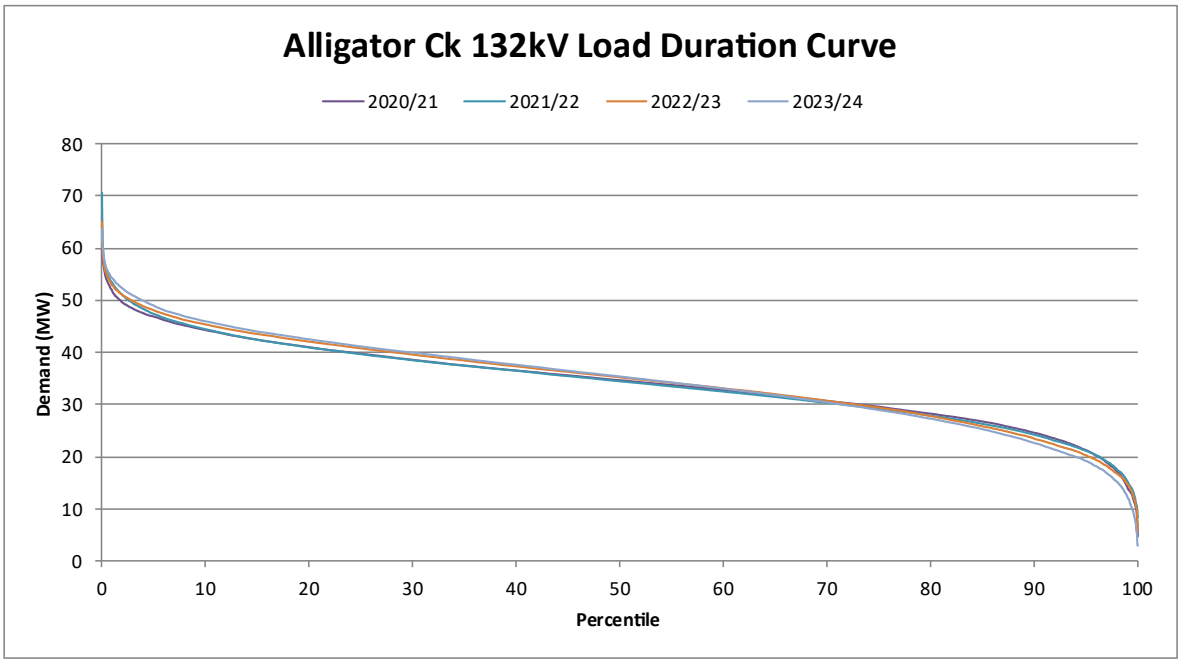



Figure 4. Alligator Creek 132kV Load Duration Curve

Powerlink is not aware of any major additional loads proposed or committed in the Southern Mackay area.

## 4. Statement of Investment Need

The Alligator Creek substation serves as a critical bulk supply point for the southern Mackay region. It provides electricity to the Aurizon Oonooie and Mackay Ports connections, the Hay Point and Dalrymple Bay coal loading terminals, and adjacent communities through the Ergon network. Removing the functionality of this substation would impact the reliability of supply to the loads in the Southern Mackay area.

As shown in Figure 2 there are only 2 x 132/110kV feeder bays supplying power into the Alligator Creek 132kV whilst there are 6 x 132kV feeder/transformer bays supplying power out to Energy Queensland bulk supply points and Aurizon loads. Given only 2 x 132kV sources of power it is not feasible to configure circuits to supply all of the load connections without a 132kV bus.

Therefore, the Alligator creek Substation must retain the 132kV bus. Additionally, removing individual feeder bays would have significant impact on the reliability of supply to Ergon Energy's Mackay area bulk supply points. In all cases load would be at risk for the next credible contingency.

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

## 5. Network Risk

The table below presents the load at risk as well as the energy at risk for loads connected to the Alligator Creek Substation at 132kV.

Table 1. Network Load at Risk

| At Risk | Contingency | Metric | 2024/25 | 2024/25 + PV | 2034/35 | 2034/35 + PV |
|---|---|---|---|---|---|---|
| Alligator Creek, Louisa Creek, Mackay Ports and Oonooie | Outage of 7152 (sec sys) followed by outage of 7119 caused by sec sys or trip<br>Outage of 7119 (sec sys) followed by outage of 7152 caused by sec sys or trip | Max (MW) | 63.6 | 101.7 | 67.3 | 104.2 |
| | | Average (MW) | 34.8 | 46.0 | 34.7 | 44.3 |
| | | 24h Energy Unserved Max (MWh) | 1270 | 1596 | 1448 | 1637 |
| | | 24h Energy Unserved Average (MWh) | 836 | 1105 | 832 | 1064 |
| Alligator Creek 33kV | Outage of 2T (CB 4422 or sec sys) followed by outage of 3T (sec sys or trip) | Max (MW) | 37.7 | 69.3 | 32.5 | 69.2 |
| | | Average (MW) | 10.8 | 22.0 | 10.9 | 19.1 |
| | | 24h Energy Unserved Max (MWh) | 753 | 1041 | 679 | 880 |
| | | 24h Energy Unserved Average (MWh) | 259 | 527 | 261 | 458 |
| Alligator Creek 132kV (Louisa Creek) | Outage of 7319 (CVT, isolator, sec sys) followed by outage of 7320 (CVT, sec sys or trip)<br>Outage of 7320 (CVT, sec sys) followed by outage of 7319 (CVT, isolator or trip) | Max (MW) | 41.4 | 82.7 | 41.1 | 73.4 |
| | | Average (MW) | 19.7 | 30.9 | 20.9 | 30.6 |
| | | 24h Energy Unserved Max (MWh) | 854 | 1196 | 778 | 999 |
| | | 24h Energy Unserved Average (MWh) | 473 | 742 | 501 | 734 |
| Mackay Ports (Aurizon) | Outage of 7336 (CVT, sec sys) | Max (MW) | 7.0 | 7.0 | 6.2 | 6.2 |
| | | Average (MW) | 1.7 | 1.7 | 1.8 | 1.8 |
| | | 24h Energy Unserved Max (MWh) | 80 | 80 | 81 | 81 |
| | | 24h Energy Unserved Average (MWh) | 41 | 41 | 43 | 43 |
| Oonooie (Aurizon) | Outage of 7175 (CVT, isolators, CB) | Max (MW) | 10.1 | 10.1 | 8.1 | 8.1 |
| | | Average (MW) | 2.7 | 2.7 | 2.6 | 2.6 |
| | | 24h Energy Unserved Max (MWh) | 129 | 129 | 100.4 | 100.4 |
| | | 24h Energy Unserved Average (MWh) | 65 | 65 | 62.7 | 62.7 |
| 1/2 Alligator Creek 33kV and 1/2 Louisa Creek | Outage 4122[1] (sec sys) followed by outage of 3T (sec sys, trip) or outage of 7152 (sec sys, trip)<br>Outage 4122[1] (sec sys) followed by outage of 2T (sec sys, CB, trip) or outage of 7119 (sec sys, trip) | Max (MW) | 19 | 34 | 16 | 34 |
| | | Average (MW) | 5.4 | 11 | 5.4 | 9.5 |
| | | 24h Energy Unserved Max (MWh) | 377 | 520 | 340 | 440 |
| | | 24h Energy Unserved Average (MWh) | 129 | 263 | 130 | 229 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1/2 Alligator Creek 33kV and 1/2 Louisa Creek | Outage 4112(1) (sec sys) followed by outage of 2T (sec sys, CB, trip) or outage of 7119 (sec sys, trip)<br>Outage 4112(1) (sec sys) followed by outage of 3T (sec sys, trip) or outage of 7152 (sec sys, trip) | Max (MW) | 19 | 34 | 16 | 34 |
| | | Average (MW) | 5.4 | 11 | 5.4 | 9.5 |
| | | 24h Energy Unserved Max (MWh) | 377 | 520 | 340 | 440 |
| | | 24h Energy Unserved Average (MWh) | 129 | 263 | 130 | 229 |

Note:

(1) For an outage of either coupler CB 4112 or CB 4122, then the 33kV bus at Alligator Creek and Louisa Creek substations are split

## 6. Non Network Options

The Alligator Creek Substation supplies Ergon Energy and Aurizon loads in the southern Mackay area (Louisa Creek, Alligator Creek 33kV, Mackay Ports and Oonooie).

To meet the Alligator Creek substation demand, the non-network solution must be capable of delivering up to 67MW and 1448MWh per day.

Powerlink is not aware of any Demand Side Solutions (DSM) in the Mackay area supplied from Alligator 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 prior to project approval.

## 7. Network Options

### 7.1 Proposed Option to address the identified need

The recommended option is to replace the at-risk primary and secondary systems reaching end of life at Alligator Creek Substation.

This option ensures that all reliability of supply and asset condition criteria are met as well as maintaining the supply reliability into the Southern Mackay area.

### 7.2 Option Considered but Not Proposed

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

#### 6.2.1 Do Nothing

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

## 8. Recommendations

Powerlink has reviewed the condition of the primary and secondary systems at Alligator Creek Substation.

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

Retaining Alligator Creek Substation will allow Powerlink to continue to meet its (N-1-50MW/600MWh) Transmission Authority reliability standard.

Powerlink is currently unaware of any feasible alternative options to minimise or eliminate the load at risk at Alligator 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.

## 9. References

1. T065 Alligator Creek Primary Plant Condition Assessment Report – April 2025
2. Alligator Creek Secondary System Condition Assessment Report – May 2024
3. CP.02800 Alligator Creek Substation Reinvestment – Project Scope Report
4. 2025 Transmission Annual Planning Report (A6049612)
5. Asset Planning Criteria - Framework (ASM-FRA-A2352970)
6. Powerlink Queensland's Transmission Authority T01/98

# Project Scope Report

# CP.02800

# Alligator Creek Substation Reinvestment

## Concept – Version 5

### Document Control

Change Record

| Issue Date | Revision | Prepared by | Reviewed by | Approved by | Background |
|---|---|---|---|---|---|
| 30 May 2025 | 5 | [redacted] | | [redacted] | Update to include earth switch and isolators in bay D01<br>PIF reference updated<br>Removed 50V DC system replacement from scope |
| 19 Mar 2025 | 4 | [redacted] | [redacted] | [redacted] | Ver. 4 – added CVT and secondary replacement works |
| 8 Oct 2021 | 3 | [redacted] | [redacted] | [redacted]mith | Ver. 3 - Revert to concept, include additional scope and rebuild options |
| 22 Apr 2021 | 2 | [redacted] | [redacted] | [redacted] | Ver. 2 - Include metering requirement |
| 3 Aug 2020 | 1 | [redacted] | [redacted] | [redacted] | Ver. 1 - Proposal initial issue |

Related Documents

| Issue Date | Responsible Person | Objective Document Name |
|---|---|---|
| 14 March 2025 | [redacted] | PIF_T065 Alligator Creek Selective Primary Plant Replacement [A5792391] |
| 29 May 2024 | [redacted] | T065 132kV Alligator Creek Secondary Systems Replacement [A5503733] |

## Document Purpose

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

## Project Contacts

| | |
|---|---|
| Project Sponsor | [redacted] |
| Connection & Development Manager (Aurizon) | [redacted] |
| Connection & Development Manager (Ergon) | [redacted] |
| Strategist – Primary | [redacted] |
| Strategist – Secondary Systems | [redacted] |
| Planner – Main/Regional Grid | [redacted] |
| Manager Projects | [redacted] |
| Project Manager | TBA |
| Design Manager | TBA |

## Project Details

### 1. Project Need & Objective

T065 Alligator Creek substation was established in the early 1980s. It is a 132/33kV bulk supply point for the southern Mackay region providing supply to the Aurizon Oonooie and Mackay Ports connections, the Hay Point and Dalrymple Bay coal loading terminals and surrounding communities via the Ergon network.

Primary plant from the original substation establishment is aged over 40 years and maintenance records indicate emerging critical issues with equipment in the132kV bays. Instrument transformers from the original installation are in reasonable condition for their age apart from minor oil leaks, however are porcelain-housing type, and based on available statistical data have increased probability of catastrophic failure presenting high safety risk.

Installed capacitive voltage transformers, manufactured by Trench, are known for their high failure rate, leading to unplanned outages and negatively affecting the reliability of the network.

Selected circuit breakers are now operating with reduced reliability due to age related condition issues, including recurring SF6 leaks. Manufacturer support is no longer available and there are limited spares, resulting in increased risk of failure with extended repair duration. A number of disconnectors and earth switches have high contact resistance and corrosion of various parts requiring increased maintenance. There are also potential electrical clearance issues in bay D05, necessitating replacement of the transformer circuit breaker and the current transformers with a Dead Tank Circuit Breaker (DTCB).

A condition assessment of the secondary systems was carried out in 2024 and identified that the protection and control devices for the 132kV bays will reach the end of their technical asset life in 2028.

The objective of this project is to replace selected 132kV primary plant and secondary systems at Alligator Creek substation, including relocation of the metering point to the 132kV side of Transformer 2, by October 2028.

This project will follow the two (2) stage approval process and is subject to a RIT-T.

## 2. Site Overview and Project Drawing


*Figure 1: Location of Alligator Creek Substation*

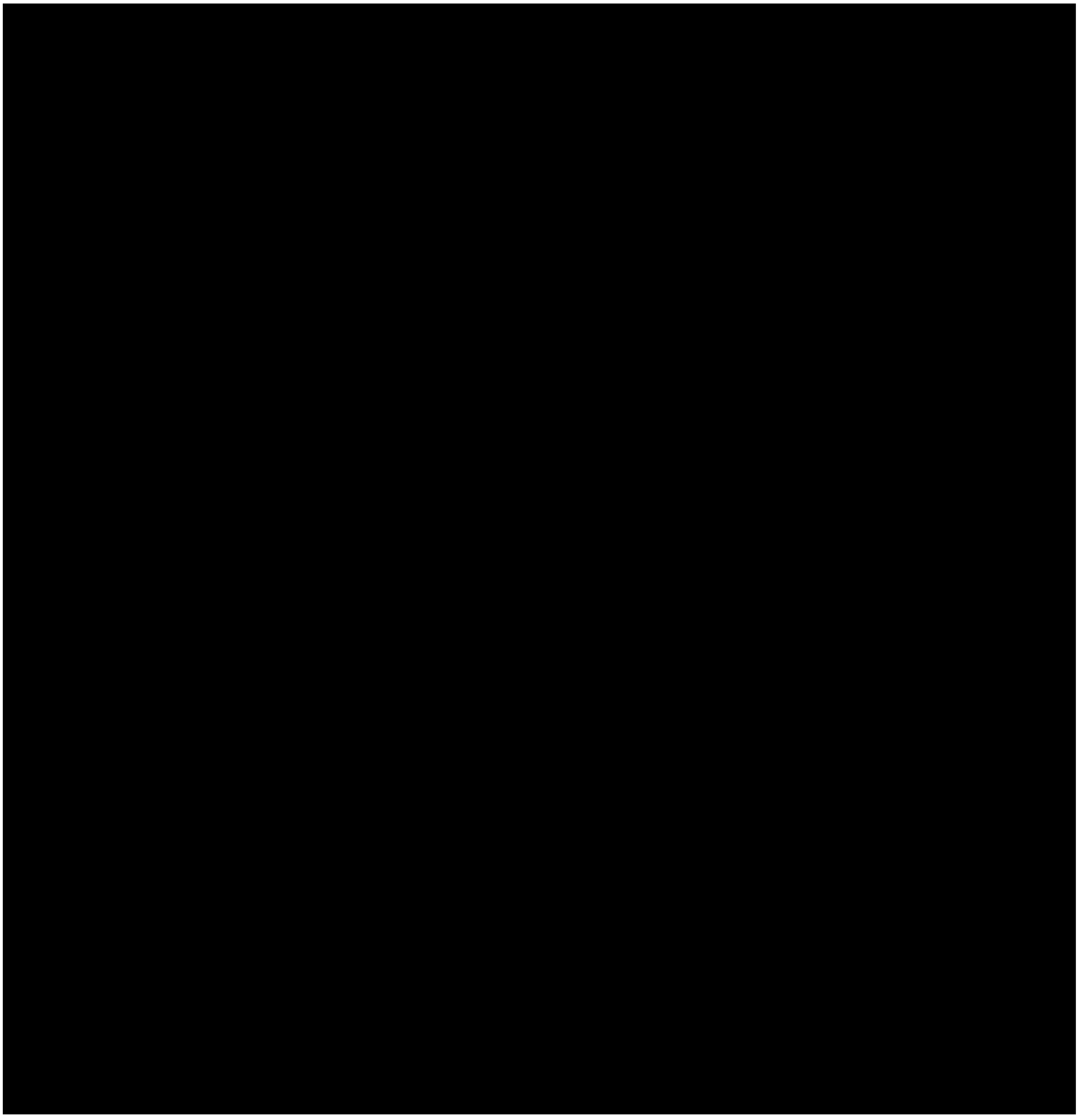


*Figure 1: Alligator Creek Existing Line Diagram H-117167-001*

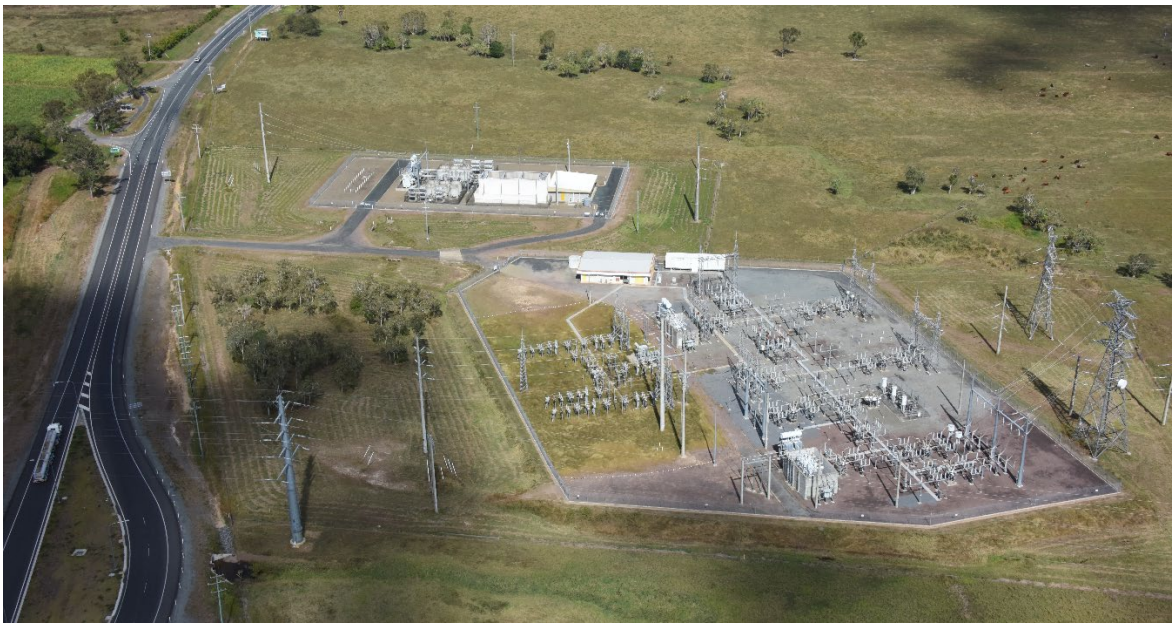


*Figure 2: Alligator Creek Substation Aerial View*

## 3. Deliverables

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

This project will follow the two stage approval process. The following deliverables are to be provided for the purposes of options analysis as required under the RIT-T:

1. Preliminary feasibility assessment for each option, including inputs from design, construction and commissioning.

2. A report (e.g. Concept Estimate Report) detailing the works to be delivered, high level staging, resource requirements and availability, and outage requirements and constraints for each option. This report should include the findings and recommendations from the preliminary feasibility assessment.

3. A class 5 estimate (minimum) for each option.

    - Works associated with the Oonooie feeder bay (D06) are to be estimated as a separable portion.

4. A basis of estimate document and risk table, detailing the key estimating assumptions and delivery risks for each option.

5. Outline staging and outage plans for each option.

6. Provide a high level project schedule for each option and identify any requirements for early funding to meet the commissioning date (e.g. procurement of long lead time equipment).

# 4. Project Scope

## 4.1. Original Scope

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

Briefly, the project involves replacement of selected 132kV primary plant and secondary systems at Alligator Creek substation, including relocation of the metering point to the 132kV side of Transformer 2.

### 4.1.1. Options

Two credible options have been identified and are summarised in Table 1 below. Standalone concept estimates are required for each option to inform feasibility and cost assessments.

Table 1 - Options summary

| Option | Strategy | Project Scope | Comm. Date |
|---|---|---|---|
| 1 | In situ replacement | In situ replacement of selected primary plant, including relocation of metering point to the 132kV side of Transformer 2.<br>In situ replacement of selected secondary systems within the existing building. | Oct 2028 |
| 2 | Mix of in situ / full bay replacement | In situ replacement of selected primary plant for bays D56, D51, D1, D5 and 1 Bus VT, including relocation of metering point to the 132kV side of Transformer 2.<br>Full bay replacement in adjacent vacant position for bay D06 (Oonooie feeder bay)<br>In situ replacement of selected secondary systems within the existing building. | Oct 2028 |

The scope requirements for each of the options are described as follows.

## 4.2. Option 1 - In Situ Replacement

### 4.2.1. Transmission Line Works

Not applicable

### 4.2.2. T065 Alligator Creek Substation Works

Primary Works

Design, procure, construct and commission the replacement of the selected 132kV primary plant listed in Attachment 1 and shown in Figure 1, with consideration of the following:

- New metering for Transformer 2 is to be installed as close as practicable to the connection point. The connection point is on the high voltage side of the transformers. (Existing metering utilises EQL 33kV CTs and VTs) Refer to Attachment 2.
- For bays requiring both CB and CT replacement, consideration should be given to utilising dead tank circuit breakers to achieve required electrical clearances;
- Point on Wave functionality is required for Transformer 2; and
- Existing structures and foundations are to be reused where possible, ensuring they are fit for purpose for a minimum of 40 years.

Secondary Works:

Design, procure, construct and commission in-situ replacement of 132kV secondary systems within the existing control buildings for the following plant:

- 132kV 1, 2 and 3 Buses;
- 132kV Feeders 7320 (D56) & 7319 (D1) to Louisa Creek (EQ) including revenue metering;
- 132kV Feeder 7152 (D54) to Pioneer Valley;
- 132kV Feeder 7119 (D4) to Nebo;
- 132kV Feeder 7175 (D6) to Oonooie;
- 132kV Feeder 7336 (D51) to QR Mackay Ports including revenue metering;
- 132kV M01 Capacitor Bank (D52);
- 132/33kV Transformer 2 (D5) including relocation of metering to transformer HVs (meters do not require replacement until 2042);
- 132/33kV Transformer 3 (D55) (meters do not require replacement until 2042);
- 132kV M02 SVC bay (D2) including revenue metering;
- 132kV Bus Coupler bays (D03 and D53);
- Review PQM panel and replace CT links as necessary;
- SCADA to provide for control and monitoring requirements including conversion from serial to DNP over TCP/IP
- OpsWAN equipment (except the camera) and relocate devices (except the camera) from the OpsWAN camera housing at the top of the pole to the camera patch box at the base of the pole;
- Change indoor secondary systems panels lighting from AC to DC;
- Confirm suitability of the existing AC supplies;

- Replace 125V (building +2) DC Systems (50V DC system is planned for replacement in 2025 under CP.02977);
- Existing single 125V DC system (building +1) is to be decommissioned or transferred to Energy Queensland;
- Modify AC and DC distribution as required to facilitate the replacement works; and
- Modify and upgrade telecommunications equipment as required to support the new secondary systems;

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

#### 4.2.3. Remote End Substation Works

Modify protection, control, automation and communications systems as required at all impacted remote end substations.

Remote end works at Oonooie to be coordinated with CP.02320 Oonooie Substation Reinvestment if possible.

#### 4.2.4. Telecoms Works

Telecoms works included under Substation Works.

Telecommunications works are to be coordinated with CP.02811 Telecommunication Network Consolidation RAN 2 and CP.02513 OpsWAN and MPLS Replacement RAN 2.

#### 4.2.5. Easement/Land Acquisition & Permits Works

Not applicable

### 4.3. Option 2 – Mix of In Situ and Full Bay Replacement

#### 4.3.1. Transmission Line Works

Design, procure, construct and commission any line works required to facilitate the rebuild of the Oonooie feeder bay (D06) in an adjacent spare bay location.

#### 4.3.2. T065 Alligator Creek Substation Works

As per scope of Option 1, with the exception of the 132kV Oonooie feeder bay (D06) as follows:

- design, procure, construct, test and commission full bay replacement of 132kV switching bay D06 in the adjacent spare bay location.
- New bay to be positioned in such a way that facilitates future expansion of the substation to the south.

#### 4.3.3. Remote End Substation Works

As per Option 1.

#### 4.3.4. Telecoms Works

As per Option 1.

#### 4.3.5. Easement/Land Acquisition & Permits Works

Not applicable

### 4.4. Key Scope Assumptions

- Alligator Creek SVC Secondary Systems will be replaced under a separate project.

### 4.5. Variations to Scope (post project approval)

Not applicable

## 5. Key Asset Risks

From an asset risk perspective, priority is to be given to replacement of bay D06 due to the porcelain instrument transformers that have increased probability of catastrophic failure presenting a high safety risk.

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

## 6. Project Timing

### 6.1. Project Approval Date

The anticipated date by which the project will be Stage 1 approved is November 2025.

### 6.2. Site Access Date

Site access is immediately available for Powerlink construction works to commence.

### 6.3. Commissioning Date

The latest date for the commissioning of the new assets included in this scope and the decommissioning and removal of redundant assets, is 31st October 2028.

The project team is to assess the earliest possible delivery date for these works (as close as possible to the proposed commissioning date) as part of the Concept Estimate and provide a schedule of key milestones and funding requirements to meet this date. The project team are to advise the Sponsor as soon as possible if preapproval funding is required to procure long lead time equipment before completion of the estimate to meet the proposed commissioning date.

## 7. Special Considerations

- Preference is to install a separate CT/VT metering unit in the Transformer 2 bay (D05) if there is sufficient space.
- Project works to include recovery and return to Powerlink stores of the SF6 CTs and the CB in bay D05.
- In developing the delivery strategy, consideration should be given to minimising customer impacts including reducing outage duration for cutovers, and minimising return to service requirements.
- Panels, marshalling kiosks and associated cabling are in good condition and consequently, condition-based replacement is not required until 2048. However, screw CT links and terminals shall be upgraded under associated secondary system replacement to mitigate associated safety risks according to SU0049 New physical disconnect terminal for CT circuits.
- In September 2020, the CTs in Bay D05 were replaced with SF6 type under emergency works due to the risk of failure and operational constraints with associated Restricted Access Zones. Project works include recovery of the SF6 CTs and their return to Powerlink stores.

## 8. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies. The preferred equipment strategy is to utilise dead tank circuit breakers based on lowest lifecycle cost and significantly reduced safety risks.

The preferred equipment strategy for voltage transformers is to use capacitor voltage transformers.

Unless otherwise advised Pat Tighe will be the Project Sponsor for this project. The Project Sponsor must be included in any discussions with any other areas of Network and Business Development.

Craig Bennett will provide the primary customer interface with Aurizon and Jay Tencate for Ergon Energy. The Project Sponsor should be kept informed of any discussions with the customers.

## 9. Asset Ownership

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

## 10. System Operation Issues

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

- Interaction of project outage plan with other outage requirements;
- An outage of the transformers will involve the Township of Alligator Creek (population~1300) and surrounding areas and put load at risk. Load transfers to Mackay will need to be investigated to permit long recall times;

- An outage of feeder 7175 (Bay D06) involves a complete outage of T105 Oonooie which is an Aurizon substation, complete with SVC. Outages will likely be restricted to Aurizon maintenance days and require negotiation with the customer.
- likely impact of project outages upon grid support arrangements; and
- likely impact of project outages upon the optical fibre network.

## 11. Options

An estimate is required for each of the options as described in Section 4 above.

## 12. Division of Responsibilities

A Division of Responsibilities document is required to cover the changes to the interface boundaries with Ergon Energy at Alligator Creek. The Project Manager is required to draft the document and consult with the Project Sponsor to arrange sign-off between Powerlink and Ergon Energy.

## 13. Related Projects

| Project No. | Project Description | Planned Comm Date | Comment |
|---|---|---|---|
| Pre-requisite Projects | | | |
| CP.02977 | DC System Replacement – 2024 and 2025 | 2025 | Project to replace Alligator Creek 50V System |
| Co-requisite Projects | | | |
| CP.02320 | Oonooie Substation Reinvestment | 2028 | Definition |
| Other Related Projects | | | |
| C55.1443 | Alligator Creek SVC Sec Sys Refurbishment | TBA | |
| CP.02812 | CP.02812 Telecommunication Network Consolidation RAN 3 | 2029 | |
| CP.02514 | OpsWAN and MPLS Replacement RAN 3 | 2029 | |

## Attachment 1: Primary Plant to be replaced under CP.02800

| Functional Location | Object Type | Manufacturer |
|---|---|---|
| T065-D01-7319-1VTA | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D01-7319-1VTB | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D01-7319-1VTC | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D01-7319-73190 | SUB_ES | |
| T065-D01-7319-73191 | SUB_IS | |
| T065-D01-7319-73193 | SUB_IS | |
| T065-D05-442--2TRFCTA | SUBS0015 [CT] | ASEA |
| T065-D05-442--2TRFCTB | SUBS0015 [CT] | ASEA |
| T065-D05-442--2TRFCTC | SUBS0015 [CT] | ASEA |
| T065-D05-4422 | SUBS0010 [CIRCUIT BREAKER] | ABB Sweden |
| T065-D06-7175-5VTA | SUBS0009 [CVT] | HAEFELY |
| T065-D06-7175-5VTB | SUBS0009 [CVT] | HAEFELY |
| T065-D06-7175-5VTC | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D06-7175-71750 | SUBS0016 [EARTH SWITCH] | SIEMENS |
| T065-D06-7175-71751 | SUBS0021 [DISCONNECTOR] | SIEMENS |
| T065-D06-7175-71752 | SUBS0010 [CIRCUIT BREAKER] | MITSUBISHI |
| T065-D06-7175-71753 | SUBS0021 [DISCONNECTOR] | SIEMENS |
| T065-D06-7175-7175CTA | SUBS0015 [CT] | MODERN PRODUCTS |
| T065-D06-7175-7175CTB | SUBS0015 [CT] | MODERN PRODUCTS |
| T065-D06-7175-7175CTC | SUBS0015 [CT] | MODERN PRODUCTS |
| T065-D06-7175-7175SAA | SUBS0031 [SA (GAPLESS)] | Hitachi |
| T065-D06-7175-7175SAB | SUBS0031 [SA (GAPLESS)] | Hitachi |
| T065-D06-7175-7175SAC | SUBS0031 [SA (GAPLESS)] | Hitachi |
| T065-D51-7336-11VTA | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D51-7336-11VTB | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D51-7336-11VTC | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D56-7320-10VTA | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D56-7320-10VTB | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-D56-7320-10VTC | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-KD--KD1--12VTA | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-KD--KD1--12VTB | SUBS0009 [CVT] | TRENCH ELECTRIC |
| T065-KD--KD1--12VTC | SUBS0009 [CVT] | TRENCH ELECTRIC |

## Attachment 2: T065 Alligator Creek Customer Connections

# CP.02800 Alligator Creek Substation Reinvestment

# Concept Estimate

## Table of Contents

# 1. Executive Summary

This concept estimate has been developed based on the CP.02800 Alligator Creek Substation Reinvestment Project Scope Report – Version 5. For this project option 2 has been chosen as this is expected to be the preferred option as it significantly reduces the required outage of Aurizon's Oonooie substation and SVC.

T065 Alligator Creek substation was established in the early 1980s. It is a 132/33kV bulk supply point for the southern Mackay region providing supply to the Aurizon Oonooie and Mackay Ports connections, the Hay Point and Dalrymple Bay coal loading terminals and surrounding communities via the Ergon network.

Primary plant from the original substation establishment is aged over 40 years and maintenance records indicate emerging critical issues with equipment in the132kV bays. Instrument transformers from the original installation are in reasonable condition for their age apart from minor oil leaks, however are porcelain-housing type, and based on available statistical data have increased probability of catastrophic failure presenting high safety risk.

Installed capacitive voltage transformers, manufactured by Trench, are known for their high failure rate, leading to unplanned outages and negatively affecting the reliability of the network.

Selected circuit breakers are now operating with reduced reliability due to age related condition issues, including recurring SF6 leaks. Manufacturer support is no longer available and there are limited spares, resulting in increased risk of failure with extended repair duration. A number of disconnectors and earth switches have high contact resistance and corrosion of various parts requiring increased maintenance. There are also potential electrical clearance issues in bay D05, necessitating replacement of the transformer circuit breaker and the current transformers with a Dead Tank Circuit Breaker (DTCB).

A condition assessment of the secondary systems was carried out in 2024 and identified that the protection and control devices for the 132kV bays will reach the end of their technical asset life in 2028.

The objective of this project is to replace selected 132kV primary plant and secondary systems at Alligator Creek substation, including relocation of the metering point to the 132kV side of Transformer 2.

*The assessment in this proposal has established that the project can be delivered by October 2028.*

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

## 1.1 Project Estimate

No escalation costs have been considered in this estimate.

| | | Total ($) |
| --- | --- | --- |
| **Estimate Class** | 5 | |
| Base Estimate – Un-Escalated (2025/2026) | | 26,309,102 |
| **TOTAL** | | **26,309,102** |

## 1.2 Project Financial Year Cash Flows

No escalation costs have been considered in this estimate.

| DTS Cash Flow Table | Un-Escalated Cost ($) |
| --- | --- |
| To June 2027 | 1,187,602 |
| To June 2028 | 5,683,295 |
| To June 2029 | 14,008,645 |
| To June 2030 | 5,289,690 |
| To June 2031 | 139,870 |
| **TOTAL** | **26,309,102** |

# 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 | | | |
| CP.02977 | DC System Replacement – 2024 and 2025 | December 2025 | Project to replace Alligator Creek 50V DC System |
| CP.02929 | Sumner Secondary Systems Replacement | September 2026 | First project to utilise the in-panel replacement methodology. |
| Interactions | | | |
| CP.02320 | Oonooie Substation Reinvestment | 2028 | Currently in Concept phase |
| Other Related Projects | | | |
| CP.02812 | CP.02812 Telecommunication Network Consolidation RAN 3 | 2029 | Currently in Concept phase |
| CP.02514 | OpsWAN and MPLS Replacement RAN 3 | 2029 | Future project |

## 2.2 Site Specific Issues

The following site-specific issues are to be resolved:

- T065 Alligator Creek Substation is located at Bruce Highway Alligator Creek (Mackay - Qld), Sarina. It is located 15km south of Mackay just after the Hay Point turnoff, travelling south. The substation is on the west side of the Bruce Highway.
- The substation was established in the early 1980s. It is a 132/33kV bulk supply point for the southern Mackay region providing supply to the Aurizon Oonooie and Mackay Ports connections, the Hay Point and Dalrymple Bay coal loading terminals and surrounding communities via the Ergon network.
- The Mackay area is subject to the following average number of days of rain. Consideration was given to this when developing the project schedule:

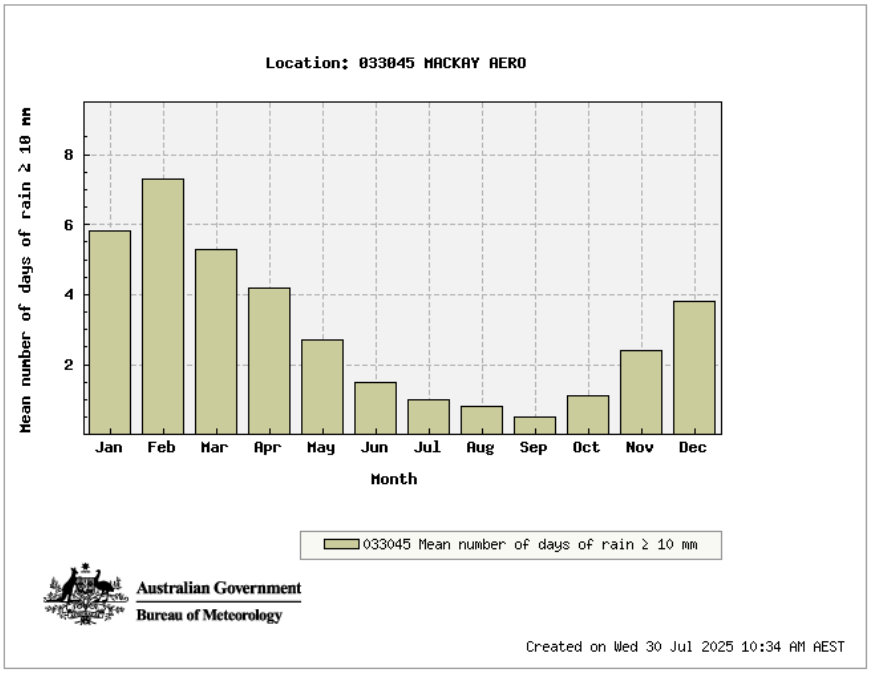



*Figure 1 - Number of Days of Rain >10mm Mackay (Source: Bureau of Meteorology 28th June 2025)*

- Asbestos containing material (ACM) has been identified at T065 Alligator Creek Substation in the communications room and presumed to be present in the ceiling of the existing control building. The risk rating is assessed as low. If major refurbishment works are undertaken within the building, care will be taken to prevent ACM exposure.
- From an asset risk perspective, priority is to be given to replacement of bay D06 due to the porcelain instrument transformers that have increased probability of catastrophic failure presenting a high safety risk.

# 3. Project Scope

## 3.1 Substations Works – T065 Alligator Creek

The project involves replacement of selected 132kV primary plant and secondary systems at Alligator Creek substation.

- Design, procure, construct, test and commission the in-situ replacement of selected primary plant for bays D56, D51, D01, D05 and 1 Bus VT.
- Relocation of the metering point to the 132kV side of Transformer 2.
- Design, procure, construct, test and commission full bay replacement of 132kV Oonooie switching bay D06 in the adjacent spare bay location.
- Design, procure, construct, test and commission the line work to facilitate the switching replacement of 132kV Oonooie D06 to the adjacent spare bay location.
- Design, procure, construct, test and commission selected secondary system replacements in-situ within the existing building for the following plant:
    - 132kV 1, 2 and 3 Buses;
    - 132kV Feeders 7320 (D56) & 7319 (D1) to Louisa Creek (EQ) including revenue metering;
    - 132kV Feeder 7152 (D54) to Pioneer Valley;
    - 132kV Feeder 7119 (D4) to Nebo;

- 132kV Feeder 7175 (D6) to Oonooie;
- 132kV Feeder 7336 (D51) to QR Mackay Ports including revenue metering;
- 132kV M01 Capacitor Bank (D52);
- 132/33kV Transformer 2 (D5) including relocation of metering to transformer HVs (meters do not require replacement until 2042);
- 132/33kV Transformer 3 (D55) (meters do not require replacement until 2042);
- 132kV M02 SVC bay (D2) including revenue metering; and
- 132kV Bus Coupler bays (D03 and D53).

- Coordinate modification of protection, control, automation and communications systems for Energy Queensland assets at T065 Alligator Creek (free-issue of secondary systems relays).
- Decommission and recover all redundant equipment.
- Update drawing records, SAP records, config files accordingly.

## 3.2 Substation Works - Remote Ends

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

- Feeder 7119 from H011 Nebo
- Feeder 7152 from T141 Pioneer Valley
- Feeder 7175 from T105 Oonooie
- Feeder 7336 from T192 Mackay Ports
- At the following Energex substations (free-issue of secondary systems relays).
  - T176 Louisa Creek

The below Single Line Diagram highlights the equipment to be replaced under this Project Scope Report:

*Figure 2 - Alligator Creek Existing Line diagram (H-117167-001)*

## 3.3 Major Scope Assumptions

The following key assumptions have been made:

- There is insufficient space to install a new CT/VT unit in bay =D05.
- The metering for Transformer 2 will be moved from the LV to the HV side of the transformer via connection to the new dead tank circuit breaker CTs in bay =D05 and new 3 phase bus CVTs to replace the 1 phase CVT.
- The new dead tank circuit breaker in bay =D05 will have CT cores suitable for revenue metering.
- A new revenue metering panel will be included in the existing building.
- A new 132Kv Oonooie Feeder Bay will be constructed in the spare space adjacent to the existing bay =D06 and the feeder will be switched over to the new bay. The existing bay will be retained under this project. The new bay layout, with a view to future expansion, will be addressed in the GA design.
- The existing CVTs in bays =D01, will be replaced in-situ on new foundations and structures.
- Replacement of the secondary systems as outlined in the scope report constitutes a full secondary system replacement within the existing building utilising existing yard cabling which will be re-connected to the new panels. Allowance has been made for assumed necessary new cables.
- 50V DC system will be replaced under CP.02977 DC System Replacement.
- The Alligator Creek SVC Secondary Systems will be replaced under a separate project.
- No Restricted Access Zone will be deployed on this site during construction.
- Outages will be available on request. Please refer to Section 4.2 Network Impacts for further details.
- MSP resources will be available in the timeframes identified in the project schedule.

## 3.4 Scope Exclusions

The following items are excluded from the Project Estimate:

- The existing platform has been constructed on a fill platform of up to 2m height, so rock has not been considered.
- The estimate excludes upgrades to any existing element of the substation not detailed. This includes but not limited to internal building, amenities, roads, lights, fences and gates.
- Excavation, handling, treatment, and disposal of contaminated materials.

# 4. Project Execution

## 4.1 Project Schedule

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

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

| Milestones | High-Level Timing |
| --- | --- |
| Class 3 Project Proposal Submission | April 2026 |
| *Stage 1 Approval (PAN1)* includes funds for design & procurement | June 2026 |
| Long Lead Procurement Orders | June 2026 |
| RIT-T (assumed 26 weeks) | June 2026 – December 2026 |
| Project Development Phase 1 & Phase 2 | June 2026 – December 2026 |
| Reconcile Estimate and Submit PMP for Stage 2 Approval | February 2027 |
| *Stage 2 Approval (PAN2)* | April 2027 |
| SPA Contract Award | April 2027 |
| Site Access Date | August 2027 |
| Procurement Deliveries | September 2027 |
| Construction | September 2027 |
| Project Commissioning | October 2028 |

## 4.2 Impacts

The following network impact will need to be considered in outage planning:

- F7319 and F7320: Any outage putting T176 Louisa Creek at risk must be negotiated with the customer as disruption to supply may result in significant consequences to customer operations.
- An outage of feeder 7175 (Bay D06) involves a complete outage of T105 Oonooie which is an Aurizon substation, complete with SVC. Outages will likely be restricted to Aurizon maintenance days and require negotiation with the customer.
- Aurizon are extremely sensitive to outages, and therefore it is very important that they are notified of outages per the required timeframes (i.e. 13 months in advance).
- An outage of T2 (Bay D05) will involve the Township of Alligator Creek (population~1300) and surrounding areas and put load at risk. Load transfers to Mackay will need to be investigated to permit long recall times.

## 4.3 Resourcing

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

## 5. Project Asset Classification

| Asset Class | Base ($) | Base (%) |
| --- | --- | --- |
| Substation Primary Plant | 6,749,470 | 25 |
| Substation Secondary Systems | 18,341,289 | 70 |
| Telecommunications | 1,218,342 | 5 |
| Overhead Transmission Line | - | 0 |
| **TOTAL** | **26,309,102** | **100** |

## 6. References

| Document name and hyperlink (as entered into Objective) | Version | Date |
| --- | --- | --- |
| Project Scope Report | 5 | 30/05/2025 |

# Risk Cost Summary Report

# CP.02800

# Alligator Creek Substation Reinvestment

## Document Control

Change Record

| Issue Date | Revision | Prepared by |
|---|---|---|
| 23/12/2025 | 1.0 | Asset Strategies |
| | | |
| | | |

Related Documents

| Issue Date | Responsible Person | Objective Document Name |
|---|---|---|
| | | |
| | | |
| | | |

## Document Purpose

The purpose of this model is to quantify the base case and option risk cost profiles for equipment at the Alligator Creek Substation which are proposed for reinvestment under CP.02800. These risk cost profiles are then included as part of an overall cost-benefit analysis (CBA) to understand the economic benefit of the proposed upgrades. This process provides a benchmarking and internal gate process to support Powerlink in effectively identifying prioritised infrastructure upgrades.

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

Primary plant and Secondary systems have been assessed via independent models; however, their overall risk costs have been summed to produce a single analysis for the project.

## Key Assumptions

In calculating the risk cost arising from a failure of the ageing equipment at Alligator Creek Substation, the following modelling assumptions have been made:

**Primary Plant**

- The functionality of the equipment is assumed to decay according to decay curves calculated by Powerlink, and associated probability of failure (PoF).
- Where equipment in scope is replaced, its associated Health Index (HI) score is reverted to one. Where refurbishment is undertaken, the health index is adjusted according to the target life extension.
- The likelihood of personnel within the substation in the event of explosive failure of equipment (used to calculate safety risk) is assumed to be 25% (based upon historic site entry averages), with the likelihood of resulting injury or death depending on the explosive radius of the equipment, its housing, and the total substation land area. The modelling also assumes that personnel are equally likely to be anywhere within the substation land area. No escalation to the likelihood has been made during construction as it is assumed appropriate risk assessments and risk mitigation measures are completed by the project team.
- In the event of an SF6 gas leak, it is assumed that the entire quantum of SF6 gas is leaked.
- For the purposes of the cost-benefit analysis, the total useful asset life of 40 years has been applied.
- A site-specific value of customer reliability (VCR) of $22,110 has been applied when calculating network risks.

**Secondary Systems**

- Whilst the re-investment scope of secondary systems contains a range of supporting devices (i.e monitoring equipment, revenue metering, firewalls and human machine interfaces), for simplicity of risk cost modelling only main protection relays, bay controllers and RTUs/control racks were considered.

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

- Given secondary systems have a shorter asset life, risk cost benefits have been modelled out to 2045, whereas substations assets have been modelled to 2060. This is providing a conservative view of the secondary systems benefits.

## Base Case Risk Analysis

### Risk Categories

Four main categories of risk are assessed as part of this project as consistent with Powerlink's Asset Risk Management Framework:

- Financial Risk
- Safety Risk
- Network Risk (including market impact if applicable)
- Environmental

*Table 1: Risk categories*

| Risk Category | Failure Types | Equipment in scope |
|---|---|---|
| **Substations Equipment** | | |
| Safety Risk | Explosive failure | All equipment with the potential to fail explosively |
| Financial Risk | Peaceful failure | All equipment |
| | Explosive failure | All equipment with the potential to fail explosively |
| Network Risk | Peaceful failure | All equipment related to network elements identified in the planning statement |
| Environmental Risk | Peaceful failure | Circuit breakers and current transformers containing SF6 |
| **Secondary Systems** | | |
| Financial Risk | Failure of the equipment resulting in emergency onsite replacement | All equipment |
| Network Risk | Failure of equipment resulting in de-energisation of network elements after 24 hours | Main protection relays only |

### Base Case Risk Cost

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

Risk cost associated with the equipment in scope is expected to increase from $7.31 million in 2026 to $16.56 million in 2036 and $32.99 million by 2045. Key highlights of the analysis include:

- Network risk accounts for approximately 89% of the total risk cost in 2030 reflecting its importance as a bulk supply point for load in the Mackay region.
- Financial risk is 10% of the total risk (at 2030), reflecting the cost of replacement of peaceful failures across both the primary and secondary systems assets.
- Safety risk accounts for 1% of the total risk (at 2030), reflecting a conservative assumption that personnel are unlikely to be in proximity of equipment during an explosive failure event.

A dip in risk cost can be observed in 2046 as the benefits associated with secondary systems assets roll off as highlighted in the assumptions listed above.


*Figure 1: Total risk cost*

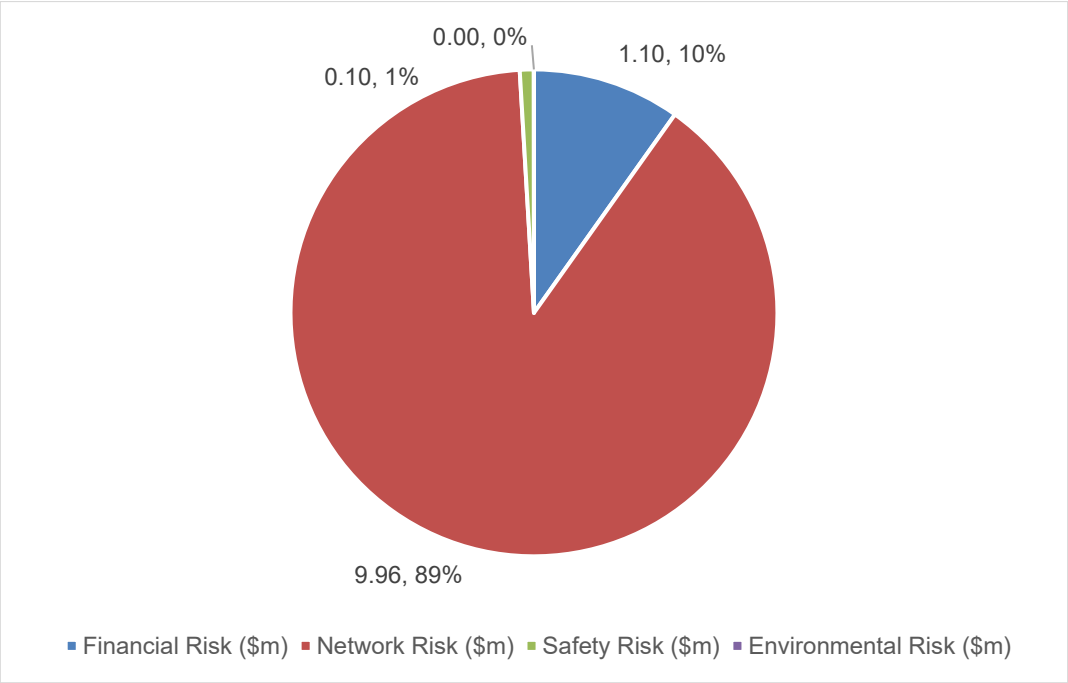



*Figure 2: Base case risk cost by contributions (2030)*

## Option Risk Cost

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

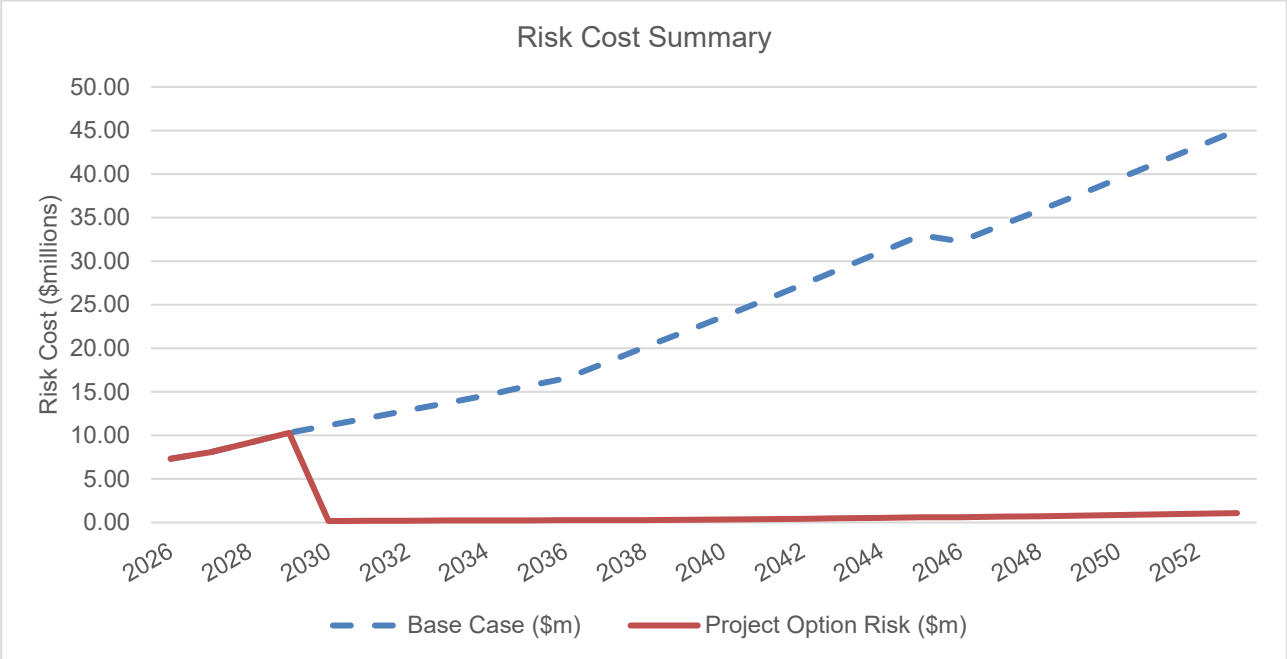



*Figure 3: Project Option Risk Cost (compared to base case)*

Following the year of investment (2029) the risk cost associated with the equipment in scope effectively reduces to approximately $0.16m. By 2045, the risk cost of the project option is approximately $0.59 million, compared with the base case risk cost of $32.99 million.

## Cost Benefit Analysis

The methodology designed for this regulatory review is set out below.

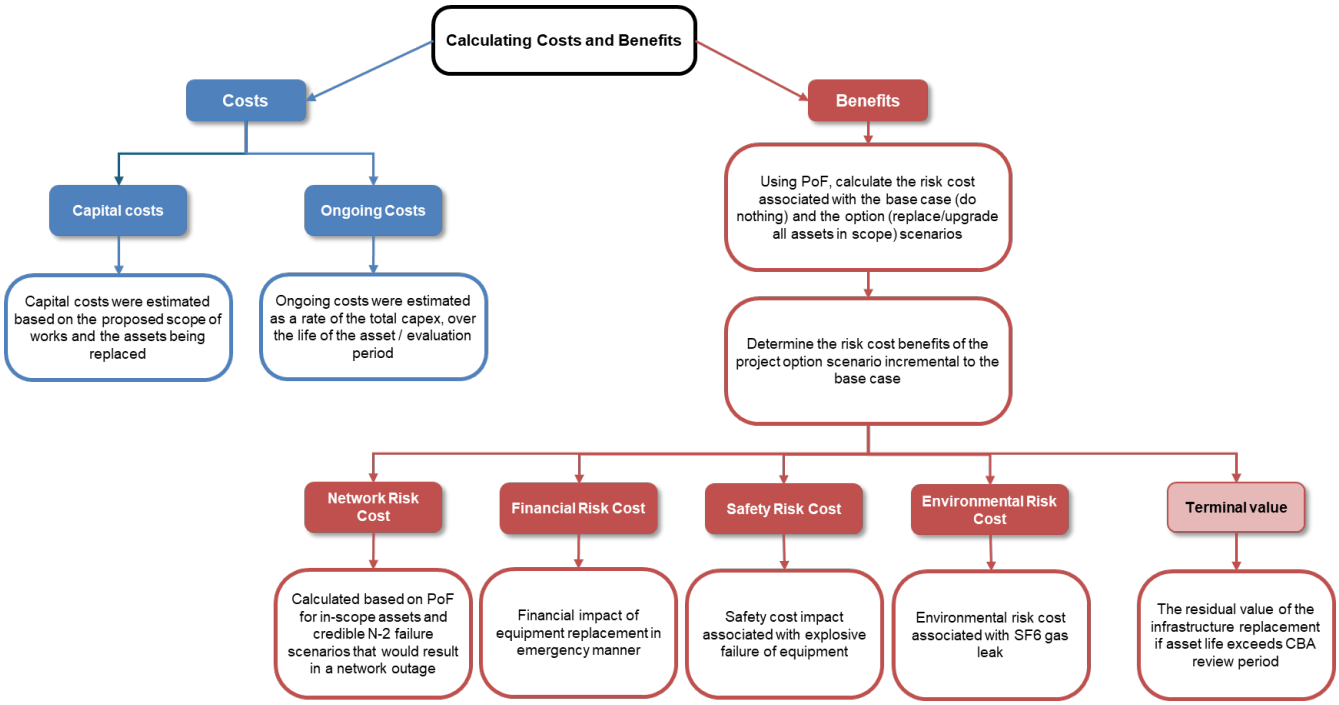



*Figure 4: CBA methodology*

The project is estimated to cost approximately $26.31 million.

Based on a baseline discount factor of 7%, the project has a net present value (NPV) of $197.4 million over a 35-year period, and a benefit-cost ratio (BCR) of 10.84.

*Table 2: Net Present Value and Benefit-Cost Ratio*

| | | Present Value Table ($m) | | |
|---|---|---|---|---|
| **Discount rate** | **%** | **3%** | **7%** | **10%** |
| **NPV of Net Gain/Loss** | $m | $455.4 | $197.4 | $113.2 |
| **Benefit-Cost Ratio** | ratio | 20.48 | 10.84 | 7.30 |

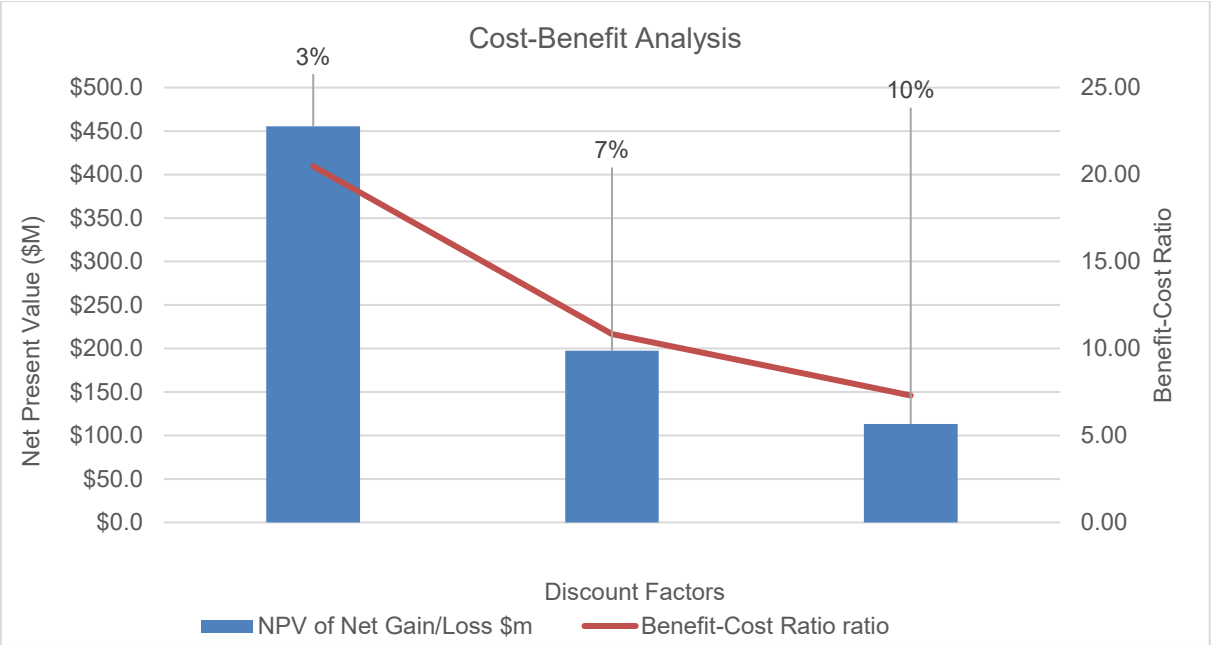



*Figure 5: Cost benefit summary*

## Participation Factors

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

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

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

The model is most sensitive to:

- **changes in value of customer reliability or changes in the restoration time** results in a decrease in risk cost of $4.98 million (44.6%) and 4.82 (43.1%) million respectively in 2030, when individually halved.

*Table 3: Participation Factors*

| Input | Baseline value | Sensitivity value (-50%) | Change in risk cost at 2030 ($m) | Participation (%) |
|---|---|---|---|---|
| **Safety** | | | | |
| Likelihood of personnel within substation | 25% | 12.5% | -0.05 | -0.46% |
| Cost consequence of multiple fatality | $11,400,000 | $5,700,000 | -0.02 | -0.14% |
| Cost consequence of single fatality | $5,700,000 | $2,850,000 | -0.01 | -0.13% |
| Cost consequence of multiple serious injury | $4,206,600 | $2,103,300 | -0.01 | -0.10% |
| **Financial** | | | | |
| Emergency premium (peaceful failure) | 20% | 10% | -0.05 | -0.43% |
| Emergency premium (explosive failure) | 300% | 150% | -0.03 | -0.23% |
| Emergency replacement cost without spares – Relay ($m) | 0.09 | 0.05 | -0.08 | -0.7% |
| Emergency replacement cost without spares – Bay Controller ($m) | 0.20 | 0.10 | -0.14 | -1.3% |
| **Network** | | | | |
| VCR ($/MWh) | 28,580 | 14,290 | -4.98 | -44.62% |
| Restoration Time (hrs) | 72-720 (subs)<br>Relay - no spare (10) | 36-360<br>Relay - no spare (5) | -4.82 | -43.14% |