January 2026

Powerlink 2027-32 Revenue Proposal

Project Pack

CP.02170 Chinchilla Substation Replacement

Project Status: Stage 1 Approved

Network Requirement

The Chinchilla Substation was established in 1984 at the same time as the Tarong Power Station development. It is a 132/110/33kV bulk supply point for mining and pastoral industries in the Darling Downs area west of Tarong. The substation was originally owned by Ergon Energy but some of the 132kV assets were transferred to Powerlink in 2012 as part of Powerlink's broader Surat Basin network development. As part of the Surat Basin network development Powerlink established a new 275kV substation at Columboola which provides additional support to Chinchilla from the west.

Some of the primary plant dates from the original substation establishment and is now over 40 years old. The original circuit breakers are a pneumatic spring type operating mechanism and no longer supported by the manufacturer. They have experienced a number of failures of air valves within the air system with the only available replacements being second hand and already in poor condition. Some instrument transformers are porcelain-housing type, and based on available statistical data have increased probability of catastrophic failure presenting high safety risk [1].

A condition assessment indicates that the original secondary systems devices have reached the end of their technical asset life and do not provide full redundancy of protection functions. The design and configuration of both secondary systems panels and marshalling kiosks present safety risks to operating personnel. SCADA and control functions for Powerlink assets are still hosted on Ergon energy systems. The driver for replacing secondary systems is the obsolescence and end of manufacturer support for the existing relays along with non-compliance with current standards [2]. Ageing secondary systems, which are no longer supported by the manufacturer, and primary plant showing signs of deterioration at Chinchilla 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.

Planning studies have confirmed an enduring need to maintain electricity supply into the Chinchilla area, with peak demand forecast to remain steady in the area for the next ten years. In order to continue to meet the reliability standard within Powerlink's Transmission Authority, the services currently provided by Chinchilla Substation are required into the foreseeable future to meet ongoing customer requirements [3].

Recommended Option

The identified need and credible options in relation to the condition of the Chinchilla Substation were assessed via a public Regulatory Investment Test for Transmission (RIT-T) consultation process completed in July 2022. Two credible options for investment in Chinchilla Substation were identified in the RIT-T consultation [8]:

Option 1: Replace all assets on a like-for-like basis.

Option 2: Reconfigure Chinchilla Substation and replace selected assets.

The economic analysis in the RIT-T assessment identified that Option 2 provides the greatest net economic benefits and is therefore the preferred option.

Cost and Timing

The estimated cost of Option 2 to reconfigure Chinchilla Substation and replace selected assets is $16.6 million ($2025/26) [5].

Target Commissioning Date: September 2027.

Documents in CP.02170 Project Pack

Public Documents

1. T013 Chinchilla Primary Plant Condition Assessment Report
2. T013 Chinchilla Secondary System Condition Assessment Report
3. Maintaining reliability of supply in the Tarong and Chinchilla local areas – Project Assessment Conclusions Report
4. CP.02170 Chinchilla Substation Replacement – Project Scope Report
5. CP.02170 Chinchilla Substation Replacement – Concept Estimate

T013 CHINCHILLA

PRIMARY PLANT CONDITION ASSESSMENT REPORT

Report requested by:	[redacted]ic	**Request Date:**	01/02/2019
Report Prepared by:	[redacted]	**Date of site visit:**	03/07/2019
AUTHOR/S:	[redacted]		
Report Approved by:	[redacted]	**Report Approval Date:**	06/08/2019
Report Reviewed by:	[redacted]	**Review Date:**	05/08/2019
Issue Approved by:	[redacted]	**Issue Date:**	07/08/2019

Date	Version	Objective ID	Nature of Change	Author	Authorisation
07/08/2019	0	A3155302	Initial Issue	[redacted]	[redacted]
24/09/2025	1	A3155302	Desktop update	[redacted]	[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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EXCECUTIVE SUMMARY

This report provides an overview of the condition of the Powerlink owned high voltage equipment at T013 Chinchilla substation, as per defined scope below. The report is intended to identify asset condition triggers requiring intervention in a way of refurbishment or replacement of high voltage substation equipment, their supporting structures and associated substation infrastructure. The report contains recommendations and suggestions triggering condition based or corrective maintenance activities.

The assessment has been formulated based on data extracted from the 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 and the site inspection conducted on 03/07/2019.

The summary of recommendations is contained in Table 9 presented in Section 3 of this report.

1. INTRODUCTION

Version 0 of the condition assessment is based on information acquired through a site visit conducted on 03/07/2019, available design data and drawings, updated SAP data (April 2019) and the civil condition assessment report dated 18/07/2019 (Objective Id. A3158770). Version 1 of this condition assessment has updated the report with available design data, drawings and updated SAP data available up to 24th of September 2025.

1.1 System information

T013 Chinchilla Substation was established in 1984 to provide supply for mines and pastoral industries within the area, located west of Tarong. The substation was established by Powerlink and at a later date was transferred to Ergon Energy. In 2012 some of the 132kV assets and associated protection systems were transferred back to Powerlink (see Figure 1 for details of current ownership). In 2023 the two feeders to H018 Tarong substation were de-energised and decommissioned along with the associated bays within T013 Chinchilla. As two 132 kV feeders bays, one 132 kV transformer bay and 132 kV bus owned and operated by Powerlink remained energised, Chinchilla is still a shared site with Energy Queensland who owns the site, power transformers, one 132 kV transformer bay, all 110 kV switchgear and bus as well as 33 kV bus and switchgear and the majority of site infrastructure.

The Powerlink assets in this substation consist of one132 kV transformer bay, two bays for two 132kV feeders to Columboola, two spare 132kV bays which were originally connected to Tarong, a 132kV bus section bay (without circuit breaker) and 132 kV bus including the associated secondary system and communication assets.

[redacted]

Figure 1 -: Single Line Diagram

Figure 2 - Airial photo of Chinchilla substation

[redacted]

Figure 3 - T013 Chinchilla General Arrangement

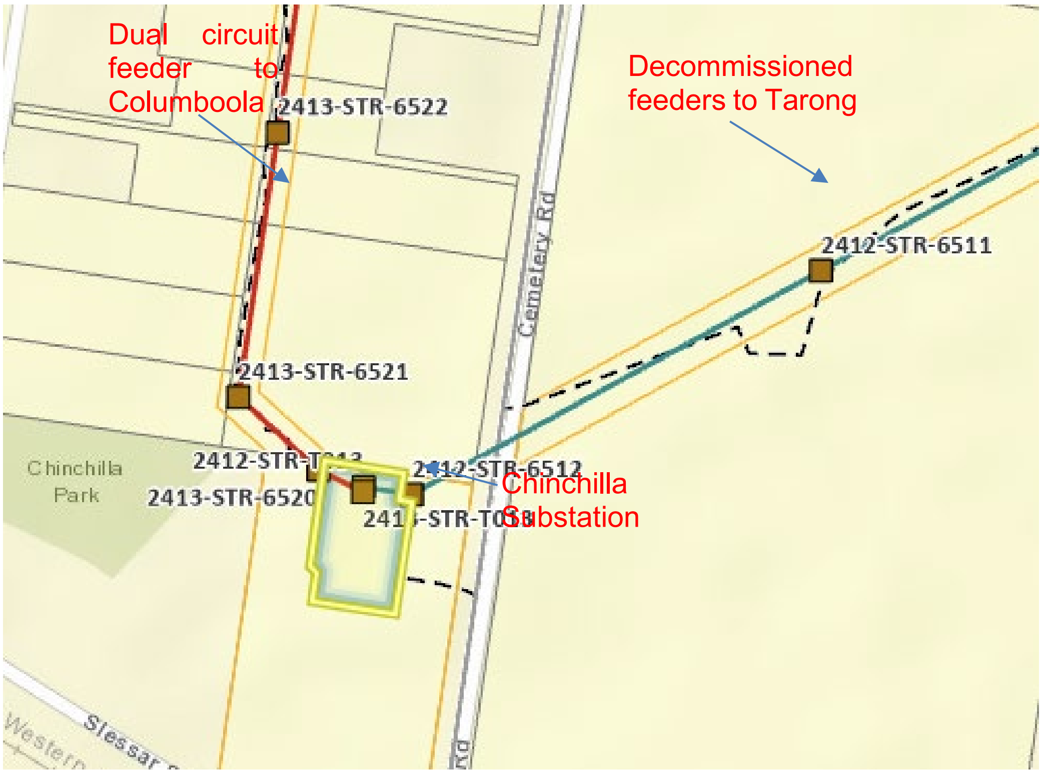

Figure 4 - Overview of Chinchilla HV Supply Network

1.2 Asset age

The Chinchilla 132/33kV substation was established in the mid-1980s, with equipment replacements as detailed below.

Upgrades/changes undertaken at this site by Powerlink in the last 20 years include:

- CP.02110 Chinchilla and Columboola 132kV metering
- CP.02183 Chinchilla OpsWAN Establishment
- CP.02882 Chinchilla BESS Connection
- OR.02326 BS2412 132kV Tarong Chinchilla Decommissioning

In addition to these, Ergon Energy (now Energy Queensland – EQL) has established a new 132/33 kV transformer No.3 and associated transformer bay including a small busbar extension.

Apart from the above additions or replacements all other originally installed equipment is still in service and is now 41 years old.

1.3 Ratings

The highest fault levels calculated in Feb 2025 are:

- 33kV Line to Ground – 13.29 kA
- 110 kV Line to Ground – 3.12 kA
- 132kV Line to Ground– 7.92 kA

Functional Loc.	Description	Start-up date	Bay Continuous Rating	Bay Fault Current Rating	Fault Current Period	Comments on rating
T013-D01-444-	132kV 4 TRANSF BAY	01/07/1986	1250A	31.5kA	1.0s	The continuous current is below standard rating (limited by the interplant connection) however is sufficient for the transformer. Fault current rating is to standard and sufficient.
T013-D02-411-	132kV 1-2 BAY	01/07/1986	2309A	31.5kA	1.0s	The continuous current is above standard and sufficient. Fault current rating is to standard and sufficient.
T013-D03-496-	SPARE 6 132KV FEEDER BAY	01/07/2012	400A	25kA	1.0s	This bay continuous current rating is limited below standard by the CT secondary thermal limit, interplant connections, line droppers and line trap. The CB and CT are rated to standard specification. The fault level is limited by the line trap and the rest of the equipment is to standard specification.
T013-D03-7349	132kV FEEDER BAY	01/07/1986	692A	31.5kA	1.0s	Continuous current is below standard specification but is acceptable. Does not limit the feeder O/H winter 2m/s rating for F71349/1 and F71349/2 but is below rating of F71349/3. Fault level is to standard.
T013-D04-7350	132kV FEEDER BAY	01/07/1992	692A	31.5kA	1.0s	Continuous current is below standard specification but is acceptable. Does not limit the feeder O/H

						winter 2m/s rating. Fault level is to standard.
T013-D05-495-	SPARE 5 132KV FEEDER BAY	01/07/2012	692A	31.5kA	1.0s	All equipment installed in this bay is below the standard continuous current rating except for the disconnectors and circuit breaker. Fault level is to standard.
T013-KD—KD1-	132kV 1 BUS DIAMETER	01/07/1986	2309A	31.5kA	1.0s	Rated above standard specification and is sufficient for load transfer
T013-KD—KD2-	132kV 2 BUS DIAMETER	01/07/1986	2309A	31.5kA	1.0s	Rated above standard specification and is sufficient for load transfer

Table 1 - Chinchilla Bay Ratings

The continuous ratings of most listed bays are below the standard bays rating of 1600A. Despite these, there is a sufficient capacity of the network in this area.

It has been identified that the following equipment does not have the continuous current rating specified in SAP:

- T013-D01-444—4443-1 Disconnector
- T013-D02-411—4117 Disconnector
- T013-D03-496—4961 Disconnector
- T013-D03-496—4963 Disconnector
- T013-D03-7349-73491 Disconnector
- T013-D03-7349-73493 Disconnector

Investigations have found that the ratings of these equipment are unable to be sourced (due to the multiple ownership transfers, many documents got misplaced) and as such should be replaced if there is an enduring need for their functionality.

Although the equipment at this site is not rated for fault currents in accordance with current Powerlink standard, all equipment with fault levels specified at this site is rated adequately for the calculated fault levels at present.

It has been identified that the following equipment does not have the fault level rating specified in SAP:

- T013-D01-444-4443-1 Disconnector
- T013-D02-411-4117 Disconnector
- T013-D03-496-4961 Disconnector
- T013-D03-496-4963 Disconnector

- T013-D03-7349-73491 Disconnector
- T013-D03-7349-73493 Disconnector
- T013-D05-495—4953 Disconnector

Investigations have found that the ratings of these equipment are unable to be sourced and as such should be replaced if there is an enduring need for their functionality.

1.4 Scope of site condition assessment

The site condition assessment is restricted to Powerlink owned high voltage equipment and associated support structures and site infrastructure at T013 Chinchilla substation with the **exclusion** of:

- Protection and control systems which are subject to a separate condition assessment report.

1.5 Reinvestment Strategy

Planning studies have identified that there is no enduring need for the double circuit Tarong to Chinchilla 132kV transmission line, although there is a strategic requirement to keep this easement. Without a 132 kV link between Tarong and Chinchilla substations, Powerlink can still meet its reliability of supply obligations. Based on this the following option is planned to be completed as part of CP.02170 Chinchilla Substation:

1. Mothball the 132kV transmission line between Tarong and Chinchilla substations (completed as of 2025) and decommission the 275/132kV transformers at Tarong substation (completed as of 2025);

It is recommended that any asset replacement recommendations indicated in this report should be undertaken in conjunction with the above proposed reinvestment strategy options.

Given there is no enduring need for the Tarong feeders, it was investigated whether the current network configuration is most appropriate. Four credible options were identified below. These should be investigated in conjunction with the planning team to find the most cost-efficient approach that is suitably reliable.

- **Feeder connected directly to transformer bay**

[redacted]

Figure 5 - Substation configuration option 1

  - This option would decrease the quantity of bays required and remove the requirement for bus and bus protection (net difference is 2 less circuit breakers from current configuration excl. reduction of bays associated with Tarong feeders). However, this option would decrease the reliability for EQL switchyard. As Chinchilla substation is connected as a Tee'd feeder to Columboola (regulated) and Cameby (non-regulated), any failure on either feeder would remove the associated Chinchilla transformer from service. As Cameby is also a non-regulated substation, any failure would inherently impact the regulated network. Any further failures on either feeder or transformer bay would cause loss of supply to the entire yard. Similarly, either transformer experiencing a failure would remove the associated feeder from service and would impact Cameby substation connection until some switching can be done.

- **No feeder bay with additional bus coupler breaker**

[redacted]

Figure 6 - Substation configuration option 2

  - This option would decrease the quantity of bays required by removing the feeder bays, however an additional breaker would be required on the bus bar (net difference is 1 circuit breaker less from current config excl. bays for Tarong feeders). This option would again decrease reliability with the transformers requiring to be disconnected should a fault on the associated feeder develop. As mentioned previously Chinchilla substation is connected as a Tee to a non-regulated substation meaning that any failure on the non-regulated asset would impact the regulated. Any further failures on either feeder or transformer bay would cause loss of supply to the entire yard. For this arrangement however, a fault in the transformer bay would be able to be isolated without removing the associated feeder from service and impact on Cameby substation.

- **No transformer bay with additional bus coupler breaker**

[redacted]

Figure 7 - Substation configuration option 3

  - This option would decrease the quantity of bays required by removing the transformers bays, however an additional breaker would be required on the bus bar (net difference is 1 circuit breaker less from current config excluding Tarong feeder bays). This option would again decrease reliability with the feeders requiring to be disconnected should a fault on the associated transformer develop. Any further failures on either feeder or transformer bay would cause loss of supply to the entire yard. For this arrangement however, a fault on the feeders would be able to be isolated without removing the associated transformer from service. This would enable a fault on the non-regulated assets connected to Cameby substation to be electrically isolated without impacting the regulated network.

- **Current configuration**

[redacted]

Figure 8 - Substation configuration option 4

  - This option increases the reliability of the substation with any feeder or transformer fault able to be isolated without disconnecting the corresponding feeder or transformer. Manual operation of disconnector 4117 would be required to supply both transformer via one feeder.

2. CONDITION ASSESSMENT

2.1 Buildings

There are 4 buildings at this site:

- Control Building +1
- Control Building +6
- Telecommunication Building +2
- Workshop

Toilet is attached to Control Building +1.

Figure 9 - Chinchilla buildings

2.1.1 Control Building +1

The control building +1 (Figure 4) is owned by Energy Queensland (EQ). The building houses protection and control equipment owned, operated and maintained by Energy Queensland along with the secondary systems/protection relays for Powerlink owned feeders 495 and 496 (decommissioned feeders), transformer bay 444 and bus bar protection (both in service). As part of CP.02170 Chinchilla substation replacement it is planned that the transformer bay and bus protection secondary system equipment will be decommissioned, and the new associated protection/secondary system equipment will be installed in Powerlink owned control building +6. The feeder bays 495 and 496 secondary system equipment will be decommissioned and removed from this building as part of the same project as there is no enduring need for these feeders.

Figure 11 - Building +1

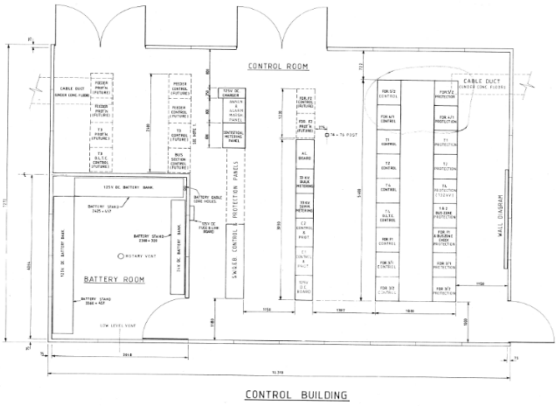

Figure 10 - Building +1 layout

2.1.2 *Control Building +6*

Control building +6 is demountable control building of total length of almost 20 m, installed in 2021. It serves as office and lunchroom, whilst other amenities are shared with Energy Queensland. It houses the secondary system/protection equipment for feeders 7349 & 7350. It is planned that part of CP.02170 substation replacement project that the bus protection/secondary systems and transformer bay protection/secondary systems will be installed in this building. It is main entry point for Powerlink. It is in good condition with some space available.

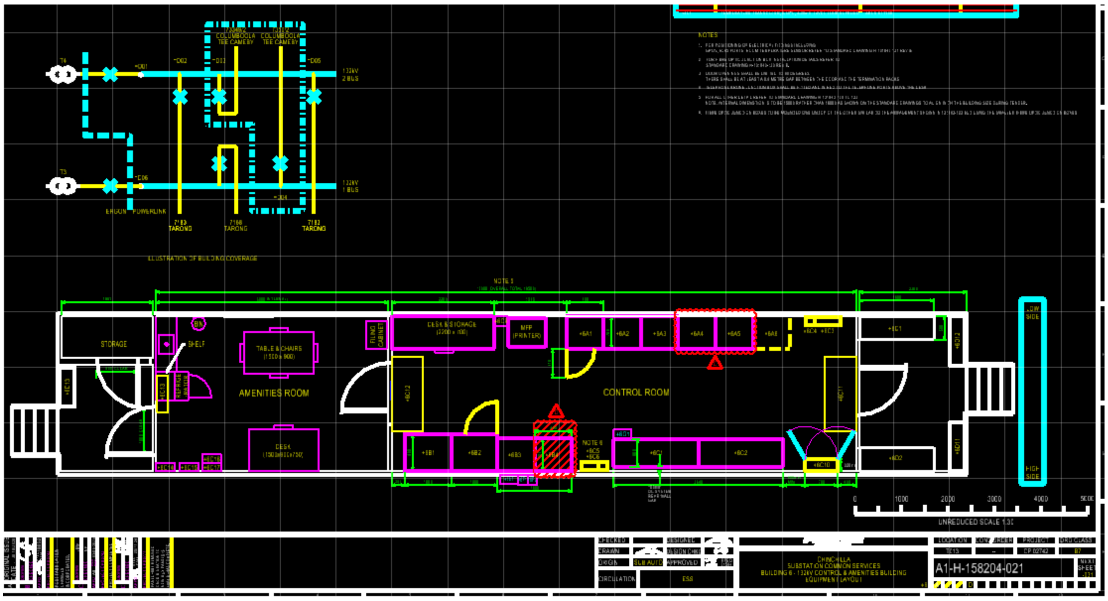

Figure 12 – Building +6 Layout

Figure 13 - Building +6

2.2 Switching bays

2.2.1 T013-D01- 444 - 132kV 4 Transformer Bay

The equipment for this bay is listed in Table 2, including their health indices.

This bay was built in 1986, with most original equipment still in service except the current transformers (CTs).

The assets in this bay were handed over to Powerlink in 2012 and therefore data on maintenance history is available only from this year onwards.

Table 2 - D01-444- Bay

Functional Loc.	Description	Manufacturer	Model number	Construction year	HI
T013-D01-444--4442-1	CIRCUIT BREAKER	Mitsubishi	120-SFM-32A	1985	8
T013-D01-444--4443-1	DISCONNECTOR	Hapam	CVE123/550	1982	6
T013-D01-444—444CTA	CT	TRENCH	SAS 145/6G	2013	3
T013-D01-444—444CTB	CT	TRENCH	SAS 145/6G	2013	3
T013-D01-444—444CTC	CT	TRENCH	SAS 145/6G	2013	3
T013-D01-444—444SAA	SURGE ARRESTOR		ZLA-X150	1986	8
T013-D01-444—444SAB	SURGE ARRESTOR		ZLA-X150	1986	8
T013-D01-444—444SAC	SURGE ARRESTOR		ZLA-X150	1986	8
T013-D01-444—444VTA	CVT	HAEFELY	CVE145/650	1983	8

The circuit breaker (CB) in this bay was manufactured by Mitsubishi. It has a pneumatic-spring type operating mechanism with SF6 gas for insulating medium. This type of CB is no longer manufactured by Mitsubishi and hence no support with parts is available. Although the presence of asbestos in the CB control cubicle was confirmed in 2018, the asbestos containing materials were removed in 2019. A number of air valves within the air system of this CB failed in the last 15 years and although many have been replaced, the replacements are all second hand and therefore not in good condition. This has been evident with a faulty air drain valve requiring further replacement in 2022. This CB suffers from corrosion, issues related to non-functional counters and indicators and issues with air leaks and relays. There are issues with lack of relevant skills to maintain this type of CB. With the spare parts shortage and breaker's mechanism becoming slower, it is estimated it can be maintained in an electrically and mechanically safe condition for a maximum of 3 years with 2-3 outages per year required to keep up with expected corrective repairs.

Figure 14 - CB

Figure 15 – CB Mech Box

The current transformers (CTs) in bay D01 were replaced in 2013. These are SF6 CTs in polymer casing and are in good condition with no corrective actions having been undertaken.

The capacitive voltage transformer (CVT) on phase A in bay D01 was manufactured in 1983 and has been in service for 42 years. According to maintenance records, it has a smashed gauge and oil level appears to be low. As its failure due to the porcelain casing can result in major safety consequences and it is clear that gaskets are significantly aged allowing moisture ingress, it is recommended to replace it within the next 3 years.

Figure 16 - A Ph. CVT and the new CT's behind.

The bus isolator visually seems to be in good condition. Maintenance activities have taken place to mitigate corroded nuts and bolts which have been painted and protected.

The surge arrestors are original from the initial installation 1984. It has been identified that they are not up to current earthing standards and have also exceeded their estimated design life of 40 years. The porcelain housing of the surge arrestors also presents an increased safety risk as surge arrestor can experience catastrophic failure mode resulting in flying shards of porcelain. These should be replaced within the next 3 years to ensure safety of personnel on site.

The associated structures and foundations in the bay have a remaining service life of more than 20 years.

Recommendation:

Based on the above observations, it is recommended to replace the circuit breaker in the next 3 years, as its failure will result in network loads being put at increased risk of losing electricity supply for a long period (due to CB not being supported and no spare parts being available and CB replacement most likely requires replacement of structure and foundations). In addition, the failure would potentially result in a significant SF6 gas leak, causing harm to environment. No explosive failures of this type of circuit breaker were recorded in Powerlink.

Due to non-standard configuration at this site, CB failure as well as CB fail scheme operation for this circuit breaker will result in loss of feeder F7349 and transformer T4 and will put load at risk for a prolonged period.

In summary, it is recommended that the CVT, SAs and CB be replaced within the next 3 years, including their structures and foundations.

It is recommended to continue monitoring condition of structures and foundations in this bay for another 5-10 years (if not replaced with the equipment) and plan their replacement in 15-25 years.

2.2.2 T013 -D02-411 1-2 Bus Section Bay

The equipment for Bay 2 is listed in Table 2, including their health indices.

Table 3 - D02-411 Bay

Functional Loc.	Description	Manufacturer	Model number	Construction year	HI
T013-D02-411--4117	ISOLATOR	HAPAM	HAB	1983	8

The assets in this bay were handed over to Powerlink in the year 2012 and therefore the data on maintenance history is available only from this year onwards. The bus section isolator visually seems to be in good condition. Maintenance work has been done to mitigate corrosion which has been painted and protected refer Figure (9). This model of disconnector is such that maintenance is difficult and contact corrosion leads to very high resistance measurements. Overheating at the contact points may result in arcing, failure of the disconnector and loss of ability to supply both transformers via one feeder. The issue of stiffness of operation and binding of the moving assembly may result in misalignment of the contacts, difficulty in operation and exacerbate the contact resistance problems leading to accelerated overheating. The main difficulty associated with the maintenance is a round bar contact and spring-loaded fingers inside the housing of the rotating arm which are difficult to access. It is recommended that this disconnector is replaced within 3-5 years.

Figure 18 - Corrosion repair on bus section disconnector.

Figure 17 - Corrosion repair on bus section disconnector.

The associated structures and foundations in the bay have a remaining service life of more than 20 years.

Recommendation:

Based on the above observations, it is recommended to replace the disconnector in the next 3-5 years. It is recommended that the existing structures and foundations are replaced during the same project.

2.2.3 T013-D03-496 – Spare 132kV Feeder Bay

The equipment for D03-496 is listed in Table 3, including their health indices.

Table 4 - D03-496 Bay

Functional Loc.	Description	Manufacturer	Model number	Construction Year	HI
T013-D03-496--6VTA	CVT	Haefely	CVE145/650	1983	7
T013-D03-496--6VTB	CVT	Haefely	CVE145/650	1983	7
T013-D03-496--6VTC	CVT	Haefely	CVE145/650	1983	7
T013-D03-496--4960	EARTH SWITCH	SIEMENS	AMB -145	1984	6
T013-D03-496--4961	DISCONNECTOR	HAPAM	HAB	1986	8
T013-D03-496--4962	CIRCUIT BREAKER	Mitsubishi	120-SFM-32A	1983	8
T013-D03-496--4963	DISCONNECTOR	HAPAM	HAB	1983	6
T013-D03-496--496CDB	Coupling Device	HAEFELEY	ESV6T	1985	5
T013-D03-496--496CTA	CT	MODERN	H427/82/2	1984	7
T013-D03-496--496CTB	CT	MODERN	H427/82/2	1984	7
T013-D03-496--496CTC	CT	MODERN	H427/82/2	1984	7
T013-D03-496--496LTB	LINE TRAP	HAEFELEY	1.0/800/64	1984	6

This bay was built in 1985 and all high voltage equipment and associated foundations and structures in this bay are original. This bay was handed over to Powerlink in the year 2012 and therefore the data on maintenance history is available only from this year onwards. This bay was repurposed from a feeder bay to Tarong substation to a spare 132kV feeder bay in 2023.

The circuit breaker (CB) in this bay was manufactured by Mitsubishi. It has a pneumatic-spring type operating mechanism with SF6 gas for insulating medium. This type of CB is no longer manufactured by Mitsubishi and hence no support with spare parts. The asbestos containing washers and other asbestos containing materials in the mechanism box have been removed. This circuit breaker, similarly to one in bay D01 had multiple issues with non-return valves in the air system but less frequently (approx. one per year from 2013 to 2018 and no notifications raised since). It is estimated that this CB is decommissioned from site as it does not have sufficient technical life to be electrically connected again.

The CTs installed in this bay have been in service for 41 years and A & C phase have recently developed slight oil leaks originating from the site glass gauge area. Though they are still testing satisfactorily in their oil sample tests, considering that they are in porcelain housing and have increased trend of explosive failures with catastrophic safety consequences after 37

years in service, it is recommended that these instrument transformers are decommissioned from site.

The CVTs indicate low oil level and it is not clear if there is an issue with gauges. It is clear that gaskets are deteriorated and allow moisture ingress. Considering these have porcelain casing and to avoid potential major safety consequences, it is recommended to decommission these CVTs.

Figure 21 - CB

Figure 20 - CT

Figure 19 - CVT

The disconnectors appear to have some minor corrosion on the bolts holding the insulators and this has been rectified by painting. Apart from this, the two disconnectors 71681 and 71683 installed in this bay are in good condition and maintenance records show no associated problems. This model of disconnector is such that maintenance is difficult and contact corrosion leads to very high resistance measurements. Overheating at the contact points may result in arcing, failure of the disconnector and loss of supply. The issue of stiffness of operation and binding of the moving assembly may result in misalignment of the contacts, difficulty in operation and exacerbate the contact resistance problems leading to accelerated overheating. The main difficulty associated with the maintenance is a round bar contact and spring-loaded fingers inside the housing of the rotating arm which are difficult to access. It is recommended that this disconnector is scrapped. Similarly, the earth switch should be scrapped during the same period. Operational engineering should be consulted to advise if any spare parts should be retained.

The associated structures and foundations in the bay have a remaining service life of more than 20 years.

Recommendation:

Based on the above observations, it is recommended to decommission and scrap the entire bay during the Chinchilla primary plant replacement project. All of the equipment is near functional end of life and operational engineering should be consulted to advise of any spare parts that should be retained. The structures and foundations should also be scrapped as part of this project.

2.2.4 T013-D03 – 7349 – 132kV Feeder Bay

The equipment for Bay D03 is listed in Table 5, including their health indices.

Table 5 - D03-7349 bay

Functional Loc.	Description	Manufacturer	Model number	Construction Year	HI
T013-D03-7349-5VTA	CAPACITOR VOLTAGE TRANSFORMER	Crompton Greaves	CVE145/650/50	2008	5
T013-D03-7349-5VTB	CAPACITOR VOLTAGE TRANSFORMER	TRENCH LIMITED	TCVT145	2016	5
T013-D03-7349-5VTC	CAPACITOR VOLTAGE TRANSFORMER	Crompton Greaves	CVE145/650/50	2008	5
T013-D03-7349-71680	EARTH SWITCH	SIEMENS	AMB -145	1984	5
T013-D03-7349-73491	DISCONNECTOR	SIEMENS	AMB -145	1986	5
T013-D01-7349-73492	CIRCUIT BREAKER	Mitsubishi	120-SFM-32A	1984	7
T013-D02-7349-73493	DISCONNECTOR	HAPAM	HAB	1983	6
T013-D03-7349-CTA	CURRENT TRANSFORMER (SF6 - GAS)	ABB	TG145	2020	1
T013-D03-7349-CTB	CURRENT TRANSFORMER (SF6 - GAS)	ABB	TG145	2020	1
T013-D03-7349-CTC	CURRENT TRANSFORMER (SF6 - GAS)	ABB	TG145	2020	1

This bay was built in 1985 and all the primary plant in this bay are original. The assets in this bay were handed over to Powerlink in the year 2012 and therefore the data on maintenance history is available only from this year onwards.

The circuit breaker (CB) in this bay was manufactured by Mitsubishi. It has a pneumatic-spring type operating mechanism with SF6 gas for insulating medium. This type of CB is no longer manufactured by Mitsubishi and hence has no support. The model is obsolete and as such no spare parts for the 120-SFM-32A are available for purchase. There was a presence of asbestos within the heaters in the mechanism box but this has been removed. This circuit breaker had a non-return valve in the air system faulty and replaced in 2015 and also spare parts are hard to source. It is estimated that this CB has a remaining service life of another 3-5 years.

All three phases of the CTs were replaced in 2022 due to an unrepairable oil leak developing on B phase. No maintenance items have been raised against these CTs since installation, and they are in good condition.

The B phase CVT (manufactured by Crompton Greaves) in this bay was replaced in 2020 due to an onset of elevated secondary volts that indicated imminent failure. The A & C phase CVTs in this bay were manufactured by Crompton Greaves in 2008 and seem to be in good condition. The main earth insulation is falling off on both A & C phase CVTs due to degradation and this requires rectification works to be completed.

The disconnectors appear to have some minor corrosion on the bolts holding the insulators and this has been rectified by painting. Apart from this the two disconnectors 73491 and 73493 installed in this Bay are in good condition and maintenance records show no associated problems. The 73493 disconnector is a problematic model of disconnector that has difficult maintenance and contact corrosion which leads to very high resistance measurements. Overheating at the contact points may result in arcing, failure of the disconnector and loss of supply. The issue of stiffness of operation and binding of the moving assembly may result in misalignment of the contacts, difficulty in operation and exacerbate the contact resistance problems leading to accelerated overheating. The main difficulty associated with the maintenance is a round bar contact and spring-loaded fingers inside the housing of the rotating arm which are difficult to access. It is recommended that this disconnector is replaced within 5 years.

The associated structures and foundations in the bay have a remaining service life of 20 years.

Figure 22 - CB

Figure 23 - CT

Recommendation: Based on the above observations, it is recommended to replace the circuit breaker in the next 3 years, as its failure will result in triggering CB fail leading to loss of load of Chinchilla substation and loss of both feeders and F7394 and Transformer T4 for an extended period (due to the CB not being supported and no spare parts being available and the CB replacement most likely requires replacement of structure and foundations). In addition, the failure would potentially result in significant SF6 gas leak, causing environmental damage. No explosive failures of this type of circuit breaker were recorded in Powerlink.

Based on the above observations, it is recommended that the disconnectors and the CB be replaced within the next 3 years, including their support structures and foundations.

If structures and foundations are not replaced, it is recommended to continue monitoring their condition for another 5-10 years and plan their replacement in 15-25 years.

2.2.5 T013- D04 -7350 132kV Feeder Bay

The equipment for D04 is listed in Table 6, including their health indices. This bay was built in 1990 and all the primary plant in this bay are original. The assets in this bay were handed over to Powerlink in the year 2012 and therefore the data on maintenance history is available only from this year onwards.

Table 6 - D04-7350 Bay Equipment

Functional Loc.	Description	Manufacturer	Model number	Construction Year	HI
T013-D05-7183-10VTA	CVT	Trench	TEMP 138C	2011	7
T013-D05-7350-10VTB	CVT	Trench	TEMP 138C	2011	7
T013-D05-7350-10VTC	CVT	Trench	TEMP 138C	2011	7
T013-D04-7350-73500	EARTH SWITCH	WESTRALIAN	ES-132	1990	6
T013-D04-7350-73501	DISCONNECTOR	WESTRALIAN	DBRP 132	1990	5
T013-D04-7350-73502	CIRCUIT BREAKER	Sprecher Energie	HGF312 3 PAR P	1990	7
T013-D04-7350-73503	DISCONNECTOR	SWITCHGEAR	DH4	1990	6
T013-D04-7350-CTA	CT	Tyree	06/145/89	1992	7
T013-D04-7350-CTB	CT	Tyree	06/145/89	1992	7
T013-D04-7350-CTC	CT	Tyree	06/145/89	1992	7

The circuit breaker in this bay is a Sprecher Energie installed in 1990. It has a motor wound operating mechanism with spring used for energy storage and SF6 gas for insulating medium. Maintenance records from 2012 show no major issues with this CB and visibly this CB seems to be in good condition. Sprecher has stopped manufacturing high voltage CBs and sourcing spare parts is an issue. This type of CB is no longer manufactured by the manufacturer and hence obsolete. This CB was in service for the last 35 years and it is estimated that this CB has a remaining service life of 5-10 years.

Figure 26 - CB

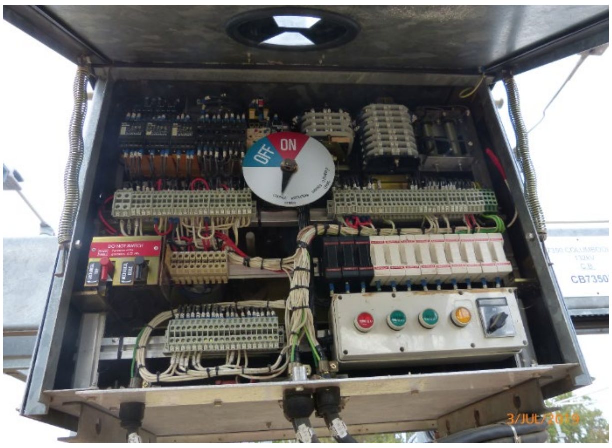

Figure 25 - CB mechanism box

Figure 24 - CT

All three phases of the CTs have been identified to have low oil level displayed in the gauge in 2024. Although visually in reasonable condition, the CTs have been in service for 33 years and considering they are in porcelain housing and have increased trend of explosive failures with catastrophic safety consequences after 37 years in service, it is recommended that these instrument transformers be replaced within 3-5 years.

The CVTs in this bay were replaced in 2016 after all three CVTs were found in faulty condition (low volts due to moisture ingress into base box). The replacement units are manufactured by Trench and are the TEMP model. No defects have been raised against these CVTs. This model of CVTs has been identified as being problematic with these CVTs suffering from a loss of the electromagnetic unit (EMU) seal which allows moisture and water to ingress into the EMU, causing significant internal damage. From investigation on failed units there appears to be evidence of a loss of CVT series capacitor elements as well. These should be replaced within 3-5 years to ensure they do not fail in service.

The two disconnectors and earth switches installed in this bay appear to be in good condition and maintenance records show no associated problems.

The associated structures and foundations in the bay have a remaining service life of 20 years.

Recommendation: Based on the above observations, it is recommended to replace the circuit breaker in the next 5 years, as its failure will result in triggering CB fail leading to loss of load of Chinchilla substation and loss of both feeders F7349 and Transformer T3 for an extended period (due to the CB not being supported and no spare parts being available and the CB replacement most likely requires replacement of structure and foundations). In addition, the failure would potentially result in significant SF6 gas leak, causing environmental damage. No explosive failures of this type of circuit breaker were recorded in Powerlink.

Based on the above observations, it is recommended that CTs, CVTs and the CB be replaced within the next 5 years, including their support structures and foundations.

If structures and foundations are not replaced, it is recommended to continue monitoring their condition for another 10-15 years and plan their replacement in 20-30 years.

2.2.6 T013- D05 -495 – 132kV Spare Feeder Bay

The equipment for D05 is listed in Table 7, including their health indices. This bay was built in 1990 and none of the high voltage equipment in this bay were replaced. This bay was handed over to Powerlink in the year 2012 and therefore the data on maintenance history is available only from this year onwards. This bay was repurposed as a spare feeder bay in 2023 when the feeder to Tarong was decommissioned.

Table 7 - D05-7183 Bay

Functional Loc.	Description	Manufacturer	Model number	Construction Year	HI
T013-D05-495--9VTA	CVT	Trench	TEMP 138C	2010	9
T013-D05-495--9VTB	CVT	Trench	TEMP 138C	2012	9
T013-D05-495--9VTC	CVT	GE GRID SOLUTIONS INDIA	CCV 170	2018	2
T013-D05-495--4950	EARTH SWITCH	WESTRALIAN	ES-132	1990	6
T013-D05-495--4951	DISCONNECTOR	WESTRALIAN	DBRP 132	1990	5
T013-D05-495--4952	CIRCUIT BREAKER	Sprecher Energie	HGF312 3 PAR P	1990	6
T013-D05-495--4953	DISCONNECTOR	WESTRALIAN	DBRP 132	1983	6
T013-D05-495--495CTA	CT	Tyree	06/145/89	1992	6
T013-D05-495--495CTB	CT	Tyree	06/145/89	1992	6
T013-D05-495--495CTC	CT	Tyree	06/145/89	1992	6

The circuit breaker in this bay is a Sprecher Energie installed in 1990. It has a motor wound operating mechanism with spring used for energy storage and SF6 gas for insulating medium. Maintenance records from 2012 show no major issues with this CB and visibly this CB seems to be in good condition. Sprecher has stopped manufacturing high voltage CBs and sourcing spare parts is an issue. This type of CB is no longer manufactured by the manufacturer and hence obsolete. This CB was in service for the last 35 years and it is estimated that this CB has a remaining service life of 5-7 years. As this CB does not have sufficient service life to be installed in a new bay, the CB should be decommissioned, and any usable spare components should be retained as spares.

Figure 27 - CB

Figure 29 - CVT

Figure 28 - CT

The CTs, although visually in reasonable condition, have been in service for 33 years and considering they are in porcelain housing and have an increased trend of explosive failures with catastrophic safety consequences after 37 years in service, it is recommended that these instrument transformers are decommissioned.

The A & B phase CVTs in this bay have been manufactured by Trench and installed in 1990. This model of CVTs has been identified as being problematic with these CVT's suffering from a loss of the electromagnetic unit (EMU) seal weakness which allows moisture and water to ingress into the EMU, causing significant internal damage. From investigation on failed units there appears to be evidence of a loss of CVD series capacitor elements as well. Both A & B phase CVT have already been noted to have oil discolouration which signifies that failure is imminent. Both of these CVTs should be decommissioned and scrapped. The C phase VT failed in 2019 and was subsequently replaced. A notification has been raised indicating that the new CVTs oil colour may be degrading. If this is confirmed the VT should be scrapped, however if it is found to be ok, this VT should be recovered as a spare.

The two disconnectors and earth switches installed in this bay appear to be in good condition. Maintenance records indicate that the isolator 4953 failed to operate properly in 2025 due to alignment issues on the B phase. Given the technical service life of the disconnectors and earth switch it is not prudent to retain these as spares. These should be decommissioned.

The associated structures and foundations in the bay have a remaining service life of 20 years.

Recommendation:

Based on the above observations, it is recommended that all instrument transformers, the CB, disconnectors and A & B phase CVT be decommissioned, including their support structures and foundations. Operational engineering should be consulted to advise if any spare parts should be kept in stores. The C phase CVT should be recovered as a spare if its condition is assessed as being sufficient.

2.3 110kV Bus Diameters/Bays

As shown in Figure 1, T013 Chinchilla has an H bus arrangement with two feeders and one transformer connected to each bus. There is a bus section bay enabling connection between two bus sections (named as Bus 1 and Bus 2).

2.3.1 1 Bus – T013-KD—KD1 - 1 Bus Bay

The equipment for 1 Bus bay is listed below in Table 8, including their health indices.

Table 8 - 1 bus equipment

Functional Loc.	Description	Manufacturer	Model number	Construction Year	HI
T013-KD--KD1--4910	EARTH SWITCH	SIEMENS	AMB-145	1984	7

The 1 bus is a solid bus installed in 1983 and made of 4.5 inch outer diameter aluminium pipe with 0.5 inch thick wall, with each phase being supported by bus support structures equipped with 132kV post insulators. Earth Switch 4910 has a fault tag from 27-09-2013 stating it was unable to be operated on the EMS. Investigation and repair is yet to be done.

The earth switch was also installed in 1983. It appears to have a number of issues related to corrosion which has affected its ability to be operated. If the bus bay is still required (depending on network configuration chosen) this earth switch should be replaced.

Recommendation: Based on the above observations, the earth switch should be replaced within 5 years (if still required depending on network configuration required).

The associated structures and foundations in the bay have a remaining service life of more than 20 years, but condition monitoring of support structures needs to continue.

2.3.2 2 Bus – T013-KD—KD2 - 2 Bus Bay

The equipment for 2 Bus is listed below in Table 7, including their health indices.

Table 9 - 2 bus equipment

Functional Loc.	Description	Manufacturer	Model number	Construction Year	HI
T013-KD2-2BU4-4920	ES	SIEMENS	AMB-145	1984	7
T013-KD2-2BU4-11VTA	2 BUS 11 EM VT	MWB TRENCH	SVS145/3	2013	3
T013-KD2-2BU4-11VTB	2 BUS 11 EM VT	MWB TRENCH	SVS145/3	2013	3
T013-KD2-2BU4-11VTC	2 BUS 11 EM VT	MWB TRENCH	SVS145/3	2013	3

The 2 bus is a solid busbar installed in 1985 and made of 4.5 inch outer diameter aluminium pipe with 0.5 inch thick wall, with each phase being supported by bus support structures equipped with 132kV post insulators. The earth switch was also installed in 1983. There is an outstanding defect regarding corrosion on the earth switch that requires rectification still. If the bus bay is still required (depending on network configuration chosen) this earth switch should be replaced.

The EMVTs were replaced in 2013 with SF6 EMVTs manufactured by Trench Limited, SVS145/3 model. These appear to be in good condition.

The associated structures and foundations in the bay have a remaining service life of more than 20 years.

Recommendation: Based on the above observations, the earth switch should be replaced within 5 years (if still required depending on network configuration required). The other plant equipment in this bay is in good condition and not expected to require replacement within the next 10-15 year period.

The associated structures and foundations in the bay have a remaining service life of more than 20 years, but condition monitoring of earth switch foundation and support structures needs to continue.

2.4 Strung Bus and Structures

Chinchilla substation has four landing spans which visually appear to be in reasonable condition.

As per the civil condition assessment report dated in 2019, the lattice towers and beams were found to be in good condition.

2.5 Site infrastructure

2.5.1 AC & DC Supply

Both AC and DC supply systems (apart from DC systems installed in Building +6) including associated switchboards are owned by Energy Queensland (EQ) and have not been assessed for this report. Powerlink should review AC and DC requirements for this site and make appropriate arrangements with EQ. The condition of DC systems owned by Powerlink will be included in Secondary Systems condition assessment report for this site.

2.5.2 Yard

2.5.2.1 Cubicles

Marshalling kiosks and cabinets were constructed from aluminium and not as per the current Powerlink standard. Marshalling kiosks for 132kV 1 & 2 bus zone (except the VT box) were originally built in 1985. Orange coloured Utilux terminals in the bay marshalling cubicles are showing signs of embrittlement. Fuses used on associated marshalling kiosks do not provide safety and monitoring features and make event investigation more difficult. Maintenance on these fuses is expensive. Based on above these Marshalling kiosks should be replaced as part of the secondary system replacement project.

2.5.2.2 Structure and equipment earthing

The structure and plant earths all appear to be in good condition apart from minor deterioration of the insulation on some of the older plant. The fence earth is only bonded to each pole.

2.5.2.3 Earth grid

2.5.2.3.1 Structure and equipment earthing

The lowest rated earth tail is suitable to conduct fault current of 37 kA for 500 ms, which is suitable for the fault current level for this site. The earth grid is owned by Ergon with the latest grid injection test being conducted in 2014. Large failures of the earthing system was found and a network access restriction was put in place. A re-design and installation of new conductors and protection settings were completed and re-tested in the same year.

2.5.2.4 Fences

The substation security fence consists of two parts. The original fence is a chain wire fence with top and bottom rail and two barbed wires above the top rail as shown in Figure 21. The fence is 2.2m high. The fence is in good condition in particular where there is a clear space between the bottom rail and the ground as shown in Figure 21. However sections of the fence along the eastern and southern boundary have soil and vegetation in contact with the bottom rail causing corrosion. As per Powerlink SSC-424 fencing standards, this is not compliant. This portion of the fence should be replaced and brought up to latest Powerlink standard.

Figure 31 - Old section of fence

Figure 30 - Old section of fence

The new part of the fence has only the bottom rail. Top of the fence is bent outwards with 8 strands of barbed wire on top of the fence. The total fence height is 3 metres. As shown in Figure 22. This part of the fence is in as new condition. This fence is per Powerlink's latest standard.

Figure 32 - New section of fence

2.5.2.5 Cable ducts and cable duct covers

The cable tranches and covers are in good condition however the covers are badly placed with many gaps increasing probability of a trip and fall.

Figure 33 - Cable trenches

2.5.2.6 Drainage

The substation drainage appears to be in a satisfactory condition. No issues with the surface water drainage were noted however the inspection was conducted in dry weather.

2.5.2.7 Roads

The substation is accessed from a local unsealed road with good and clear visibility. The internal roads are of unsealed gravel construction and are in a reasonable condition and reasonably clearly marked. No work outside of regular maintenances is required.

2.5.2.8 Switchyard lighting

The switchyard lighting appears to be in good condition. There was no corrosion visible and the clear plastic covers were still clear with no signs of clouding.

3. EQUIPMENT REPLACEMENT RECOMMENDATION - OVERVIEW

In is recommended that the below action items from the condition assessment are implemented. It is necessary to confirm the enduring need for this equipment prior to scoping of a replacement project.

Asset	Action Req. (Y/N)	Asset Replc. Recom. (Y/N)	Refurb. Recom. (Y/N)	Corr. Maint. Rec. (Y/N)	Comments
T013-D01-444-	Y	Y	N	N	Replace CB, SAs and CVTs, in 3 yrs.
T013-D02-411	Y	Y	N	N	Replace isolators in 3 yrs.
T013-D03-496--	Y	Y	N	N	Decommission entire bay. OE to advise of any spare parts to keep.
T013-D03-7349-	Y	Y	Y	Y	Replace CB and 73493 disconnectors.

					Rectify the degraded earth on A & C phase CVT.
T013-D04-7350-	Y	Y	N	N	Replace CVTs in 3 yrs. Replace CT's and CB in 5 yrs.
T013-D05-495--	Y	N	N	N	Decommission entire bay (excluding C phase CVT). OE to advise of any spare parts to keep. C phase CVT should be assessed and if acceptable returned to stores.
T013-KD—KD1	Y	Y	N	Y	Replace earth switch if bus is still required
T013-KD—KD2	Y	Y	N	Y	Replace earth switch if bus is still required

2.6 Conclusions

The condition assessment of Chinchilla 132kV substation revealed issues related to the condition of high voltage plant, unavailability of spares and therefore the inability to maintain the existing equipment. A high number of damaged porcelain insulators were also found on site. All of these represent risks to the provision of reliable supply and to safety of both personnel and public. Each risk is different and has a difference consequence, from minor to extreme. To manage the worst of these risks, replacement of plant should be undertaken within the next 3 years at the latest.

Before any asset replacements are undertaken, consideration should be given to only replacing equipment that is required to provide reliable supply to this area (Chinchilla and surrounding) in the future based on the load forecast and network operability requirements.

3. APPENDIX

3.1 Reference information

- *Equipment list (SAP)*
- *Chinchilla Civil Condition Assessment (Obj.:* A3158770*)*
- *Notifications, work orders and measurement documents (SAP)*
- *Discussions with Powerlink technical staff*
- *Discussions with the maintenance service provider*
- *Powerlink drawings*

4. HEALTH INDEX METHODOLOGY

Health index for substation equipment is based on the condition of the equipment in the bay, condition of structures and foundations (all being assigned health index as condition indicator), It provides an indication of the remaining life based on its condition and criticality, rather than based on nameplate age.

RI	Estimated Remaining Life(yrs)	Action	Comment	Comment
10	1 -2	condition assessment (CA) 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	CA 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	CA 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, CA done	
6	10 - 20	CA trigger	CA 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 CA in 5 yrs		Aged satisfactory condition.
4	25 - 30	mid-life CA (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		

Table 10 - HI Methodology Overview

T013 Chinchilla 132/110/33kV

Secondary Systems Condition Assessment Report

Document Details			
Version Number	2.0	**Principal Author**	[redacted]
Objective ID	A3165342	**Site Visit**	03/07/2019
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1. Introduction

This report is pertinent to T013 Chinchilla substation 132/110/33kV secondary systems and associated site infrastructure. The report is provided to assist with determining the future strategy and scope for refurbishment and replacement works of Chinchilla 132/110/33kV secondary systems.

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

T013 Chinchilla substation is a 132/110/33kV supply substation located at the Southern Region of Queensland for mines and pastoral industries.

T013 Chinchilla substation was owed by Energy Queensland. In 2012, Powerlink took over the ownership of 132kV substation assets as part of the strategy to extend the transmission network, supporting development in the Surat Basin. Majority of secondary systems were commissioned between 1984 and 2013.

[redacted]

T013 Chinchilla operating diagram

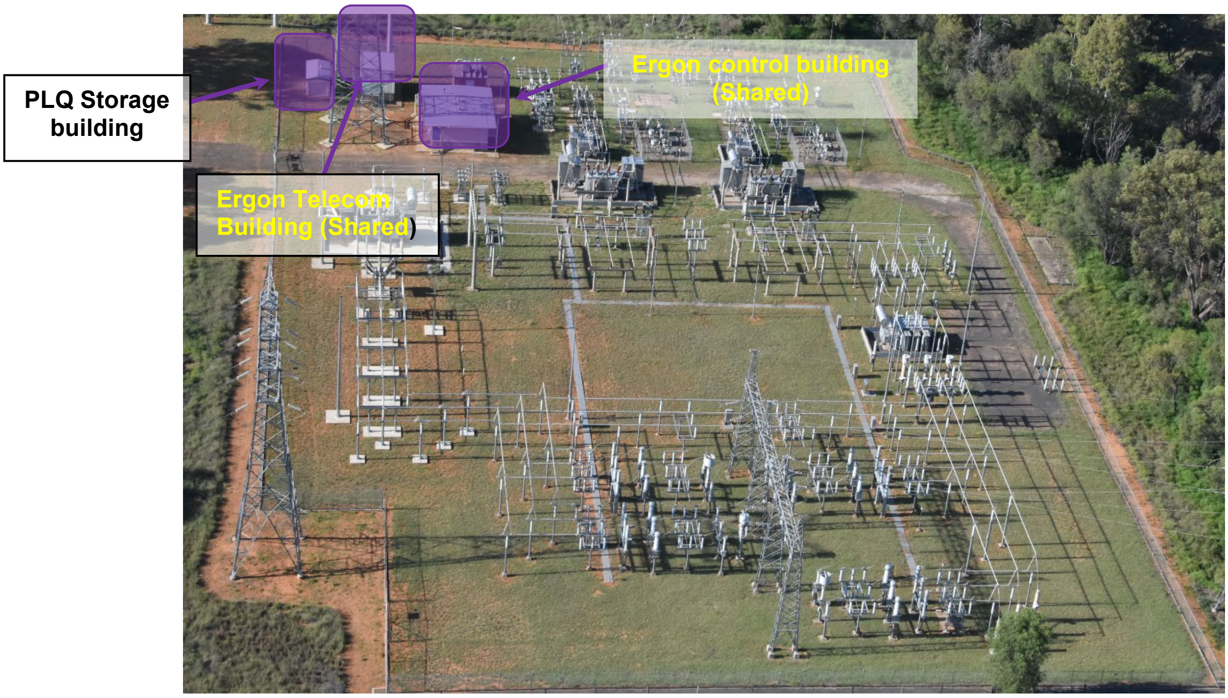
2. Site infrastructure

Chinchilla substation consists of one yard of 132/110/33kV operating voltage enclosed by one perimeter fence. 132kV system has been transfer from Energy Queensland (Former Ergon) to Powerlink in 2012. There is one control building and one communication building housing all facilities. The Chinchilla substation was built in 1984. Ergon maintenance and refurbishment have resulted in a mixture of secondary systems from 1984 through to 2013.

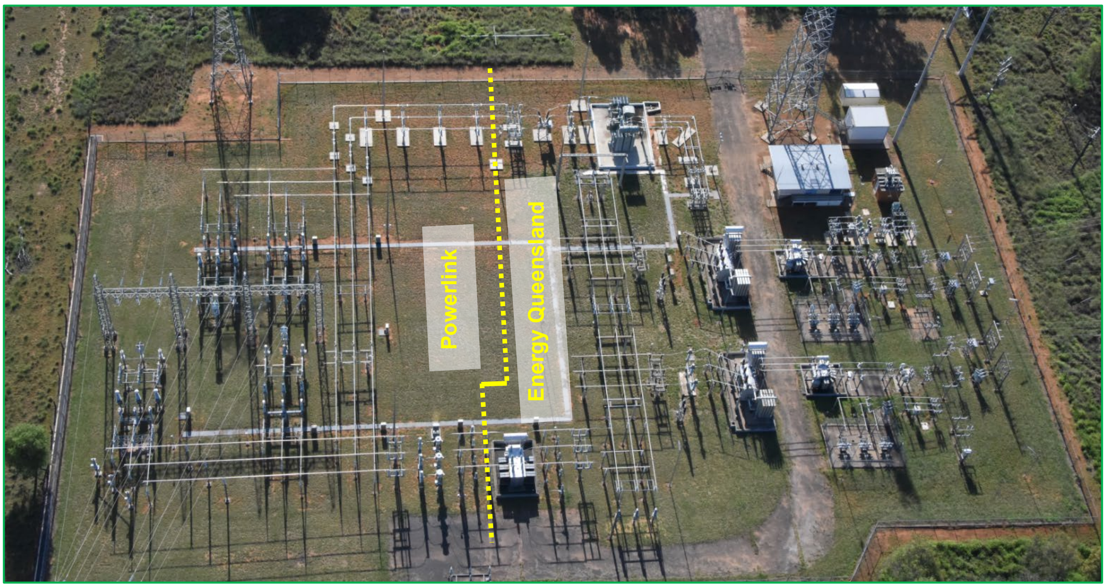
T013 Chinchilla Substation consists of:-

- 2 x 132kV buses (transferred to Powerlink from Energy Queensland);
- 4 x 132kV feeder bays (transferred to Powerlink from Energy Queensland);
- 3 and 4 Transformer bay (Energy Queensland asset excluding 4T HV CB);
- 110kV and 33kV bays (Energy Queensland assets).

132kV feeder 7168 & 7183 are connected to H018 Tarong while two 132kV feeders 7349 & 7350 are connected to T194 Columboola substation.



Chinchilla substation yard bird view



Physical asset boundary between Powerlink and Energy Queensland

According to the Asset Sale Agreement, Powerlink owns following secondary system assets:
- 132kV 1 and 2 Bus protection equipment including marshalling kiosks
- Feeder 7168, 7183, 7349 and 7350 protection and protection signalling equipment including marshalling kiosks

Follow assets are belonged to Energy Queensland:-
- Cable trenches
- Combined 132/110/33kV control and adjacent communication building
- Protection and control panels, wiring and terminations (all voltages, 132/110/33kV)
- Substation Foxboro SCD5200 control system (all voltages, 132/110/33kV) including Wonderware Local Control Facility, SCADA Link RTU and Annunciator Matrix
- Substation local AC supply, sourced from Energy Queensland 33kV Bus 1 & 2
- 48V and 125V DC batteries, chargers and distribution

3. Secondary System Assessment Methodology

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

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

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

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

The impacts of equipment obsolescence on availability is also considered when determining the recommended replacement actions. This ensures that secondary systems can be returned to service in the event of a failure within sufficient timeframes to meet regulatory requirements.

4. Condition Assessment

4.1 Buildings

The substation yard contains multiple buildings, including:-
- Combined protection and control building owned by Energy Queensland
- Combined communication building owned by Energy Queensland
- Storage building owned by Powerlink

The combined protection and control building is the main entry of the substation and contains all Powerlink and Energy Queensland secondary systems for 132/110/33kV assets. There is no any spaces available for future secondary system replacement in the existing buildings.

Protection and control building owned by Energy Queensland

Tight control building

Communication building contains PLQ and EQ telecommunication equipment.

COMMS building owned by Energy Queensland

Powerlink installed a building for equipment storage at T013 Chinchilla in 2012.

Storage building

4.2 Trench, marshalling cubicles and control cables

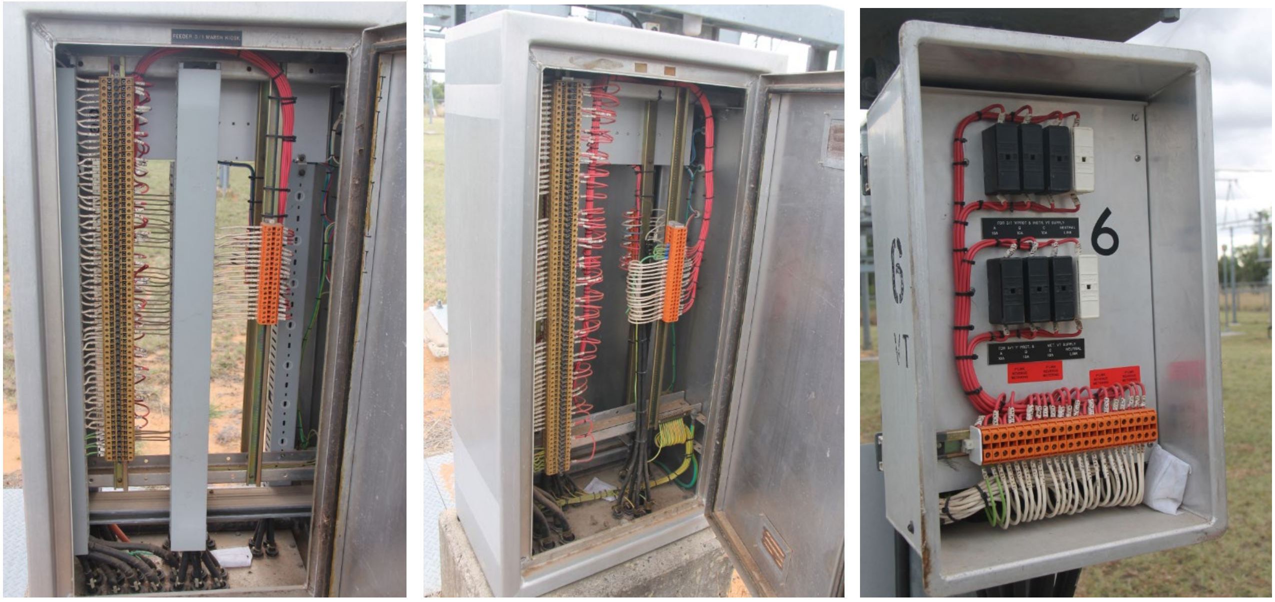
Yard trenches are owned by Energy Queensland. There are spaces to accommodate new cables for future refurbishment/replacement.

Substation trenches

Marshalling kiosks for 132kV 1 & 2 bus zone (except the VT box) were originally built in 1985. Orange coloured Utilux terminals in the bay marshalling cubicles are showing signs of embrittlement. They should be replaced with major secondary system replacement. The physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits. Associated control cables will reached the end of asset life and need to be replaced between 2020-2025. Fuses used on associated marshalling kiosks do not provide safety and monitoring features and make the event investigation more difficult. Maintenance on these fuses is expensive. These fuses should be replaced with MCBs to improve the performance of circuitries according to current design standard. Bus 2 VTs were installed in 2013. There are no condition driven replacement required for VT boxes until 2048.

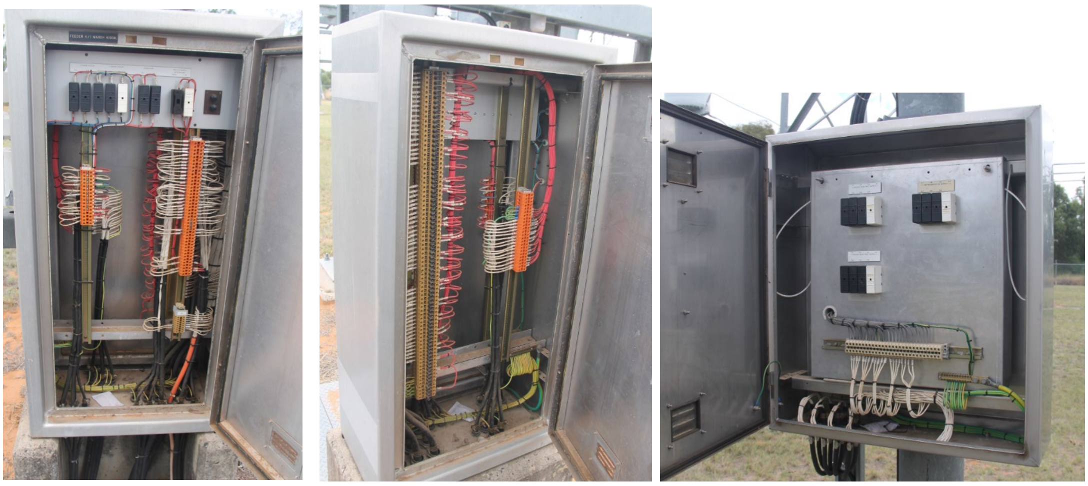
132kV bus zone marshalling kiosk and VT cubicle

Marshalling kiosks and VT box for feeder 7168 were originally built in 1985. Orange coloured Utilux terminals in the bay marshalling cubicles are showing signs of embrittlement. They should be replaced with major secondary system replacement. The physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits. Associated control cables will reached the end of asset life and need to be replaced between 2020-2025. Fuses used on associated marshalling kiosks do not provide safety and monitoring features and make the event investigation more difficult. Maintenance on these fuses is expensive. These fuses should be replaced with MCBs to improve the performance of circuitries according to current design standard.

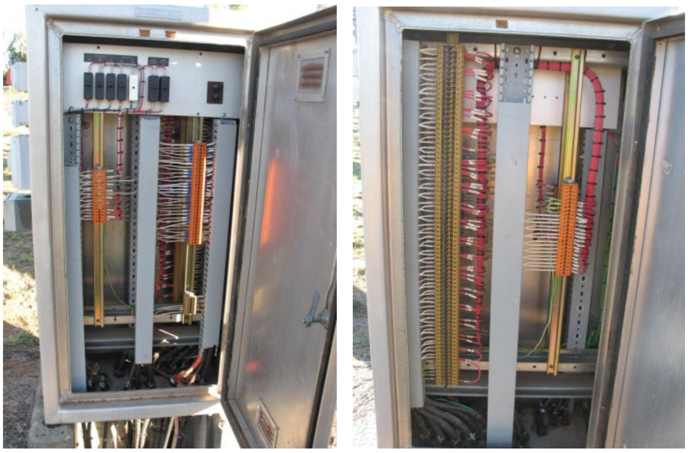


Feeder 3/1 marshalling kiosk (Feeder 7168)

Marshalling kiosks and VT box for feeder 7350 were built in 1992. Orange coloured Utilux terminals in the bay marshalling cubicles are showing signs of embrittlement. They should be replaced with major secondary system replacement. The physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits. Associated control cables will reached the end of asset life and need to be replaced between 2027 and 2032. Fuses used on associated marshalling kiosks do not provide safety and monitoring features and make the event investigation more difficult. Maintenance on these fuses is expensive. These fuses should be replaced with MCBs to improve the performance of circuitries according to current design standard.

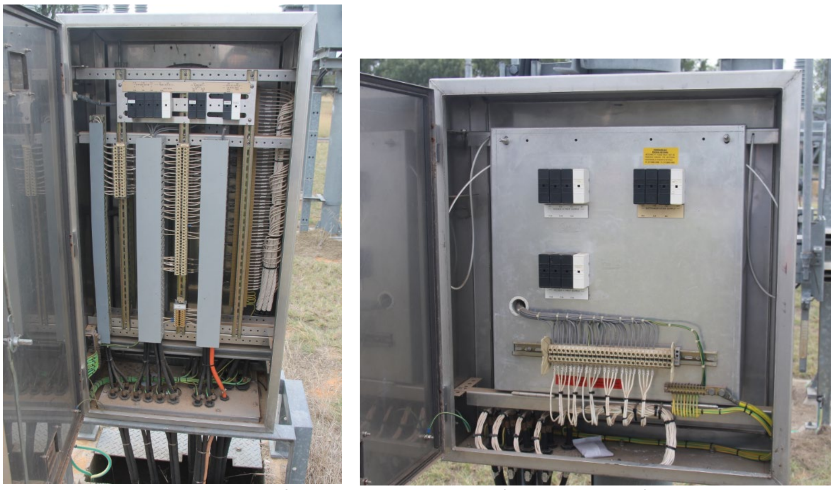

Feeder 4/1 marshalling kiosk (Feeder 7350)

Marshalling kiosks and VT box for feeder 7349 were built in 1986. Orange coloured Utilux terminals in the bay marshalling cubicles are showing signs of embrittlement. They should be replaced with major secondary system replacement. The physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits. Associated control cables will reached the end of asset life and need to be replaced between 2021 and 2026. Fuses used on associated marshalling kiosks do not provide safety and monitoring features and make the event investigation more difficult. Maintenance on these fuses is expensive. These fuses should be replaced with MCBs to improve the performance of circuitries according to current design standard.



Feeder 3/2 marshalling kiosk (Feeder 7349)

Marshalling kiosks and VT box for feeder 7183 were built in 1992. Orange coloured Utilux terminals in the bay marshalling cubicles are showing signs of embrittlement. They should be replaced with major secondary system replacement. The physical disconnect terminals for CT circuits for bay marshalling kiosks need to be replaced to mitigate CT open circuit risks with major secondary system replacement according to SU0031 New Physical Disconnect Terminals for CT Circuits. Associated control cables will reached the end of asset life and need to be replaced between 2027 and 2032. Fuses used on associated marshalling kiosks do not provide safety and monitoring features and make the event investigation more difficult. Maintenance on these fuses is expensive. These fuses should be replaced with MCBs to improve the performance of circuitries according to current design standard.



Feeder 5/2 marshalling kiosk (Feeder 7183)

4.3 Protection and control bays

4.3.1 Protection and control panels

Secondary systems at Chinchilla are housed in a type of tunnel panel which are not the current practice and represent additional safety risks for field personnel. This arrangement has separate protection and auxiliary panels. This type of construction is vulnerable to cause human error on mis-tripping of primary plant when maintenance is conducted and it is also expensive to work on because of the inter panel wiring. These panels need to be replaced to mitigate associated safety risks with major secondary system replacement.

Tunnel panel arrangement

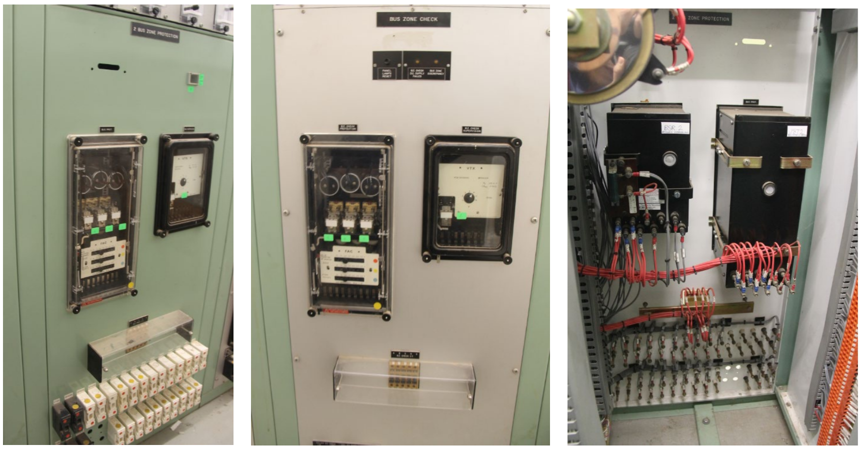
4.3.2 132kV Bus zones

Secondary systems for 132kV bus zones and coupler bays are listed in a table below.

110kV Bus	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
1 & 2 Bus	Master and supervision	[redacted]	1986	No	No	Yes	10.00
		[redacted]	1986	No	No	Yes	10.00
	Check and supervision	[redacted]	1986	No	No	Yes	10.00
		[redacted]	1986	No	No	Yes	10.00

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

Duplicate high impedance differential relays [redacted] are used to protect 132kV bus zones 1 and 2 with a master and check arrangement. This does not provide full redundancy as required by the current National Electricity Rules. These relays were installed in 1985 and have reached the end of technical asset life. These relays need to be replaced as soon as possible.



132kV Bus zone protection and control panels

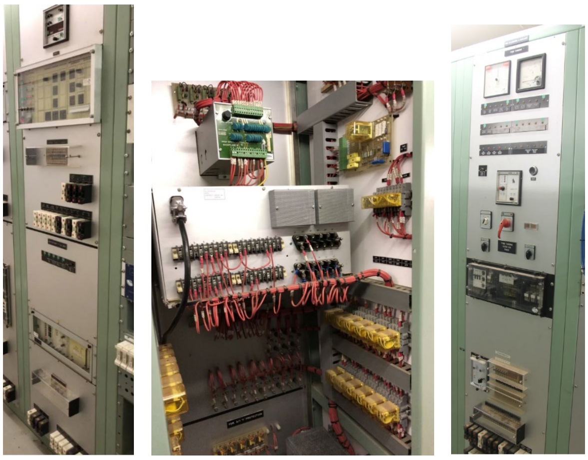
4.3.3 132kV feeder bays

Secondary systems for 132kV feeder bays are detailed in a table below.

Feeder	Relay & control	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
7168	X	[redacted]	1985	No	No	No	10.00
	Y	[redacted]	1985	No	No	No	10.00
	PROT SIG	[redacted]	1985	No	No	Yes	10.00
	Synch Check	[redacted]	1985	No	No	No	10.00
	Autoreclose	[redacted]	1985	No	No	No	10.00
7183	X	[redacted]	1992	No	No	Yes	10.00
	Y	[redacted]	2008	Yes	Yes	Yes	5.50
	PROT SIG	[redacted]	1992	No	No	No	10.00
	CB fail	[redacted]	2008	No	No	Yes	5.50
	Synch Check	[redacted]	1992	No	No	No	10.00
	Autoreclose	[redacted]	1992	No	No	No	10.00
	CVT monitoring	[redacted]	1992	No	No	Yes	10.00
7349	X	[redacted]	2008	No	No	Yes	5.50
	Y	[redacted]	2008	Yes	Yes	Yes	5.50
	Prot Sig.	[redacted]	2008	No	No	Yes	5.50
		[redacted]	2008	No	No	Yes	5.50
7350	X	[redacted]	2009	No	No	Yes	5.00
	Y	[redacted]	2009	Yes	Yes	Yes	5.00
	Prot Sig.	[redacted]	2009	No	No	Yes	5.00
		[redacted]	2009	No	No	Yes	5.00

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

Secondary systems for Feeder 7168 were installed in 1985 and associated equipment have become obsolete and there are no spares available. These secondary systems need to be replaced as soon as possible.



Feeder 3/1 7168 protection and Control & Auxiliary panel

Majority of secondary systems for Feeders 7183 were installed in 1992 and have reached the end of technical asset life. These secondary systems need to be replaced as soon as possible.

Feeder 3/1 7183 protection and Control & Auxiliary panel

Secondary systems for Feeder 7349 and 7350 were originally installed in early 1990s. Associated protection relays were replaced on the existing corridor panels between 2008 and 2009. Secondary systems for Feeder 7349 and 7350 are housed by a type of tunnel panel arrangement. This type of construction is vulnerable to cause human error on mis-tripping of primary plant when maintenance is conducted and it is also expensive to work on because of the inter panel wiring. They should be replaced between 2022 and 2025.

Feeder 7349 protection and control panel

Feeder 7350 protection and control panel

4.3.4 Bay control system

Functionalities of bay control are conducted by Energy Queensland control systems including SCD5200 RTUs. Powerlink does not own any control systems at T013 Chinchilla. For a long term, Powerlink needs to implement dedicated control systems to maintain the reliability, availability and security of the network.

4.4 Metering

Secondary systems for metering at T013 Chinchilla are listed in a table below:

Metering	Revenue and Check Meter	Model	Startup Date	Still Manufactured?	Manufacture Support?	PLQ Spares	Health Index
Transformer 4	Revenue	[redacted]	2013	No	Yes	Yes	4.23
	Check	[redacted]	2012	No	Yes	Yes	4.23
Transformer 3	Revenue	[redacted]	2008	No	Yes	Yes	4.40
	Check	[redacted]	2011	No	Yes	Yes	4.23

EDMI energy metering devices MK3 are utilized to meter 3 & 4 Transformer. These equipment were installed under CP.02110 Chinchilla and Columboola 132kV metering in 2013. There are no condition-driven replacement required until 2033.

Metering panels at T013 Chinchilla

However, metering data is currently interrogated via 3G netowrk. Powerlink has developed a solution to migrate metering to IP based metering. All meters with dial-up connection need to be migrated to IP based meter with major secondary system replacement.

4.5 Non-bays

4.5.1 SCADA, Control and OpsWAN

Energy Queensland owns all control systems at T013 Chinchilla according to associated Asset Sales Agreement. Powerlink have all SCADA information via the ICCP link between Energy Queensland and Powerlink control centre. For a long term, Powerlink should established direct SCADA path between Chinchilla substation and Powerlink control centre to maintain reliable operations.

[redacted]

T013 Chinchilla SCADA via ICCP link

The local control facility by Energy Queensland utilises Foxboro Wonderware based on normal PC hardware and provides:-

- Online overview;
- Bay pages;
- Alarm and event pages.

Energy Queensland HMI Wonderware PC was not in service when the site visit was carried out. This raised concerns on maintain Powerlink assets. Powerlink needs to implement own HMI for a long term.

HMI equipment (Wonderware PC disconnected)

OpsWAN was installed to remotely interrogate Powerlink secondary systems in 2013. These devices are in fair condition and there no condition-driven replacement required until 2023.

OpsWAN camera

4.5.2 Auxiliary supply

Auxiliary supplies come from 2 x 100KVA AC transformer from 33kV bus and are owned by Energy Queensland.

No diesel generator is available for the site. This arrangement should be reviewed with major secondary system replacement.

Both AC distribution boards and DC distribution boards have a few spares available and are owned by Energy Queensland.

AC and DC distribution boards

Both dual 125VDC and 48VDC battery banks are owned by Energy Queensland. This arrangement should be reviewed with major secondary system replacement according current Powerlink standards.


125VDC Batteries

48VDC Batteries

4.6 Telecommunication

Communication systems at T013 Chinchilla consist of PLC technology which has limitations for protection scheme implementations.

PLC equipment for Feeder 7168 and 7183

PLC equipment for Feeder 7349 and 7350

5. Summary of T013 Chinchilla Asset Health

The asset health of major equipment of T013 Chinchilla secondary system assets is determined by an assessment of the equipment aging profile, reliability, conditions (including the condition of panel wirings, control cables and marshalling cubicles) and obsolescence. Asset health index of equipment at T013 Chinchilla are summarized in the table below:-

Bay	Functional Loc.	Description	Model number	Start-up date	Manufacturer	Health Index	To be replaced by	Item	Startup date	Health Index	To be replaced by
		Protection and control equipment condition and replacement recommendation						Marshalling kiosk/Cable condition and replacement recommendation			
Bus 1 & 2	T013-SSS-NBAY-DIFPRO1	132KV BUS 1,2 MASTER RELAY	[redacted]	1986	GEC	10.00	2019	Marshalling kiosk	1985	9.71	2020-2025
	T013-SSS-NBAY-DIFPRO1	132KV BUS 1,2 MASTER CHECK RELAY	[redacted]	1986	GEC	10.00		VT box	2013	1.71	2048-2053
	T013-SSS-NBAY-DIFPRO1	132KV BUS 1,2 MASTER SUPERVISION RELAY	[redacted]	1986	GEC	10.00					
	T013-SSS-NBAY-DIFPRO1	132kV BUS 1,2 CHECK SUPERVISION RELAY	[redacted]	1986	GEC	10.00					
Feeder 7168	T013-SSS-7168-AUTOREC	F736 AUTORECLOSE RELAY	[redacted]	1985	SEAQ	10.00	2019	Marshalling kiosk	1985	9.71	2020-2025
	T013-SSS-7168-PSDIT	F7168 DIR T013 TO H018 VF PROT SIG	[redacted]	1985	DEWAR	10.00		VT box	1985	9.71	2020-2025
	T013-SSS-7168-SYNCH	SYNCH CHECK RELAY	[redacted]	1985	EMAIL	10.00					
	T013-SSS-7168-XPROT	RELAY DISTANCE 1A REYROLLE THR3PE1	[redacted]	1985	REYROLLE	10.00					
	T013-SSS-7168-YPROT	RELAY DISTANCE 1A GE SLS1503A SWITCHED	[redacted]	1985	GE	10.00					
Feeder 7183	T013-SSS-7183-AUTOREC	AUTORECLOSE RELAY	[redacted]	1992	GEC	10.00	2019	Marshalling kiosk	1992	7.71	2027-2032
	T013-SSS-7183-CBFAIL	RELAY CB FAIL 1A 125V 3PH EMAIL 2C59K4/8	[redacted]	2008		5.50		VT box	1992	7.71	2027-2032
	T013-SSS-7183-PSDIT	F7183 DIT T013 TO H018	[redacted]	1992	DEWAR	10.00					
	T013-SSS-7183-SUPERV	CVT MONITOR	[redacted]	1992	IEE	10.00					
	T013-SSS-7183-SYNCH	SYNCH CHECK RELAY	[redacted]	1992	EMAIL	10.00					
	T013-SSS-7183-XPROT	F8812 X DISTANCE PROTN RELAY	[redacted]	1992	GEC	10.00					
	T013-SSS-7183-YPROT	RELAY DISTANCE SEL 311C 1A	[redacted]	2008	SCHWEITZER	5.50					
Feeder 7349	T013-SSS-7349-PSDIT	DEWAR DM1200 PROT SIG VF 90-320V SUPPLY	[redacted]	2008	DEWAR	5.50	2022	Marshalling kiosk	1986	9.42	2021-2026
	T013-SSS-7349-PSPIT	RFL 9745 PROT SIG VF 2 TONE I/O 48-125v	[redacted]	2008	RFL ELECTRONICS	5.50		VT box	1986	9.42	2021-2026
	T013-SSS-7349-XPROT	CURR DIFF RELAY MICOM P543 + 2ND PORT	[redacted]	2008	MICOM	5.50					
	T013-SSS-7349-YPROT	RELAY DISTANCE 1A SCHWEITZER 311C 125Vdc	[redacted]	2008	SCHWEITZER	5.50					
Feeder 7350	T013-SSS-7350-PSDIT	DEWAR DM1200 PROT SIG VF 90-320V SUPPLY	[redacted]	2009	DEWAR	5.00	2022	Marshalling kiosk	1992	7.71	2027-2032
	T013-SSS-7350-PSPIT	RFL 9745 PROT SIG VF 2 TONE I/O 48-125v	[redacted]	2009	RFL ELECTRONICS	5.00		VT box	1992	7.71	2027-2032
	T013-SSS-7350-XPROT	CURR DIFF RELAY MICOM P543 + 2ND PORT	[redacted]	2009	MICOM	5.00					
	T013-SSS-7350-YPROT	RELAY DISTANCE 1A SCHWEITZER 311C 125Vdc	[redacted]	2009	SCHWEITZER	5.00					
Metering	T013-SSS-METR-REVMET1	METER KWH/KVARH EDMI 2000-0400 CL0.5 (C)	[redacted]	2012	EDMI	4.23	2031	N/A			
	T013-SSS-METR-REVMET1	METER KWH/KVARH EDMI 2000-0400 CL 0.5 R	[redacted]	2013	EDMI	4.23					
	T013-SSS-METR-REVMET2	METER KWH/KVARH EDMI 2000-0400 (REVENUE)	[redacted]	2008	EDMI	4.40					
	T013-SSS-METR-REVMET2	METER KWH/KVARH EDMI 2000-0400 CL0.5 CHC	[redacted]	2011	EDMI	4.23					
Non-bay	T013-SSS-NBAY-OWCAM1	AXIS ETHERNET CAMERA ASSEMBLY	[redacted]	2013	Take a Look	6.00	2023	N/A			
	T013-SSS-NBAY-OWNTWK1	SWITCH E/NET 32PRT RUGGED RSG2300 OPSWAN	[redacted]	2013	RUGGEDCOM	6.00					
	T013-SSS-NBAY-OWNTWK1	ROUTER CISCO 2911 48VDC - OPSWAN	[redacted]	2013	CISCO	6.00					
	T013-SSS-NBAY-OWNTWK1	SERVER PORT 48VDC PERLE 04030450 -OPSWAN	[redacted]	2013	PERLE	6.00					
	T013-SSS-NBAY-OWPRINT1	PRINTER RICOH AFICIO SP6430DN	[redacted]	2018	RICOH	1.00					
	T013-SSS-NBAY-OWSERV	TERMINAL SERVER	[redacted]	2018	ICP ELECTRONICS	1.00					

6. Recommendations

Based on the condition assessment, the main recommendations for the replacement of secondary systems equipment at T013 Chinchilla are:-

1. Replace all secondary systems for following bays by 2019, including protection and control panels:-
   - 132kV 1 & 2 Bus
   - Feeder 7168
   - Feeder 7183

2. Conduct following replacements by 2022:-
   - Replace marshalling kiosks and VT boxes for following bays:-
     - 132kV Bus 1 & 2 marshalling kiosks
     - Feeder 7168 marshalling kiosks and VT box
     - Feeder 7183 marshalling kiosks and VT box
     - Feeder 7349 marshalling kiosks and VT box
     - Feeder 7350 marshalling kiosks and VT box
   - Replace all secondary systems for Feeder 7349 and associated protection and control panels
   - Replace all secondary systems for Feeder 7350 and associated protection and control panels
   - Implement Powerlink control systems for all Powerlink owned bays including 132kV buses, Feeder 7168, 7183, 7349 , 7350 and HV CB of 4T
   - Implement dedicated Powerlink SCADA system based on DNP/IP
   - Implement HMI
   - Replace all OpsWAN equipment (including all OpsWAN cameras)
   - Provide timing clock for Powerlink secondary systems
   - Review the existing AC and DC arrangement and provide Powerlink AC and DC supply if required

3. Carry out following replacements by 2033:-
   - Replace all metering equipment based on IP metering

4. Replace 132kV bus VT box by 2050

7. References

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

Powerlink Queensland

Project Assessment Conclusions Report

21 July 2022

Maintaining reliability of supply in the Tarong and Chinchilla local areas

Document purpose

For the benefit of those not familiar with the National Electricity Rules (the Rules) and the National Electricity Market (NEM), Powerlink offers the following clarifications on the purpose and intent of this document:

1. The Rules require Powerlink to carry out forward planning to identify future reliability of supply requirements[1] and consult with interested parties on the proposed solution as part of the Regulatory Investment Test for Transmission (RIT-T). This includes replacement of network assets in addition to augmentations of the transmission network.
2. Powerlink must identify, evaluate and compare network and non-network options (including, but not limited to, generation and demand side management) to identify the '*preferred option*' which can address future network requirements at the lowest net cost to electricity customers. This assessment compares the net present value (NPV) of all credible options to identify the option that provides the greatest economic benefits to the market.
3. The document contains the results of this evaluation, and a final recommended solution to address the condition-based risks arising from the transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla Substation.

[1] Such requirements include, but are not limited to, addressing any emerging reliability of supply issues or relevant *ISP actionable projects* identified in the Australian Energy Market Operator's (AEMO) latest Integrated System Plan (ISP), for which Powerlink has responsibility as the relevant Transmission Network Service Provider (TNSP).

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Executive Summary

Tarong Substation was commissioned in 1982 and forms part of the 275kV backbone servicing South East Queensland as well as local loads in the Tarong and Chinchilla areas. The Tarong local area load includes auxiliary supply to Tarong Power Station. Chinchilla Substation was commissioned in 1986 to supply bulk electricity to the distribution network in the area via a double circuit 132kV transmission line from Tarong Substation.

Two 275/66/11kV transformers at Tarong Substation supply the local area load while two 275/132kV transformers provide back-up supply to Chinchilla. All four transformers at Tarong are nearing the end of their respective service lives, with recent condition assessments revealing a range of increasing network and safety risks arising from their continued operation. In addition, the fault level rating of these original transformers may be exceeded in the event of certain credible contingency events.

Chinchilla's secondary systems and the majority of its primary plant are also approaching the end of their respective technical lives. In particular, the secondary systems and circuit breakers are now obsolete and no longer supported by their manufacturers, with only limited spares available.

As planning studies have confirmed an enduring need for the supply of existing electricity services to the area, there is a requirement for Powerlink to address the emerging risks arising from the condition of the transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla Substation.

As the identified need of the proposed investment is to meet reliability and service standards specified within Powerlink's Transmission Authority and guidelines and standards published by the Australian Energy Market Operator (AEMO), and to ensure Powerlink's ongoing compliance with Schedule 5.1 of the Rules, it is classified as a 'reliability corrective action'[2].

This Project Assessment Conclusions Report (PACR) represents the final step in the Regulatory Investment Test for Transmission (RIT-T) process prescribed under the National Electricity Rules (Rules) undertaken by Powerlink to address the condition risks of the transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla Substation. It contains the results of the planning investigation and the cost-benefit analysis of credible options compared to a non-credible Base Case where the emerging risks are left to increase over time. In accordance with the RIT-T, the credible option that maximises the present value of net economic benefit, or minimises the net cost, is recommended as the *preferred option*.

Credible options considered

Powerlink has developed two credible network options to maintain the existing electricity services, ensuring a reliable, safe and cost effective supply to customers in the area. Both options retain the opportunity to allow for future growth and potential new connections in the area.

Powerlink published a Project Specification Consultation Report (PSCR) in August 2021 to address the condition risks of the transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla Substation. No submissions were received in response to the PSCR that closed on 22 November 2021. As a result, no additional credible options have been identified as a part of this RIT-T consultation.

The two credible network options, along with their NPVs relative to the Base Case are summarised in Table 1.

[2] The Rules clause 5.10.2, Definitions, reliability corrective action.

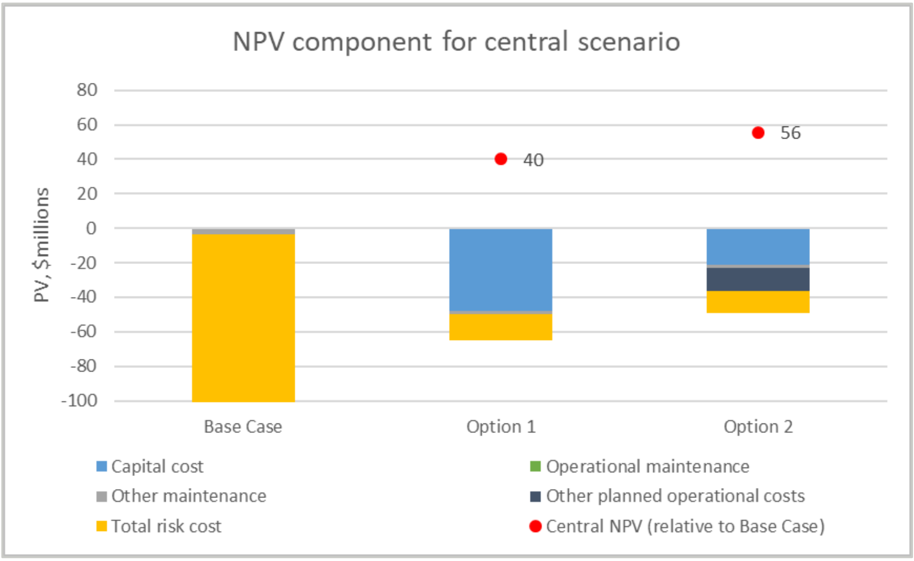
Table 1: Summary of credible options

Option	Indicative capital cost ($million, 2020/21)	Central scenario NPV relative to base case ($million, 2020/21)	Ranking
Maintain existing network topology			
Option 1: Replace all at-risk assets like-for-like by June 2025	42.88	40.0	2
Reconfigure network topology			
Option 2: Reconfigure Chinchilla and replace selected assets by June 2025	27.90	55.6	1

By addressing the condition risks, both options allow Powerlink to meet the identified need and continue to meet the reliability and service standards specified within Powerlink's Transmission Authority, Schedule 5.1 or the Rules, AEMO guidelines and standards and applicable regulatory instruments.

Figure 1 illustrates the results of the economic assessment, comparing both options to the non-credible Base Case. The credible options considered significantly reduce risk cost relative to the Base Case and both result in a positive NPV relative to Base Case.

Figure 1: Net present value of Base Case and credible network options



Evaluation and Conclusion

The RIT-T requires that the preferred option maximises the present value of net economic benefit, or minimises the net cost, to all those who produce, consume and transport electricity. The economic analysis demonstrates that Option 2 provides the greatest net economic benefit in NPV terms and is therefore the preferred option.

In accordance with the expedited process for the RIT-T, the PSCR made a draft recommendation to implement Option 2, reconfiguring Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong. The Chinchilla to Tarong transmission line will be also mothballed under Option 2, preserving the option for potential connection of renewable generation in the area should the need arise.

The indicative capital cost of the RIT-T project for the preferred option is $27.9 million in 2020/21 prices. Under this option, design work will commence in 2023 with all work completed by 2025. Powerlink is the proponent of the proposed network project.

As the outcomes of the economic analysis contained in this PACR remain unchanged from those published in the PSCR, the draft recommendation has been adopted as the final recommendation, and will now be implemented.

Dispute Resolution

In accordance with the provisions of clause 5.16B.(a) of the NER, Registered Participants, the AEMC, Connection Applicants, Intending Participants, AEMO and interested parties may, by notice to the AER, dispute conclusions in this report in relation to:

- the application of the RIT-T,
- the basis upon which the preferred option was classified as a reliability corrective action or
- the assessment of whether the preferred option has a *material inter-regional impact* or not

Notice of a dispute must be given to the AER within 30 days of the publication date of this report. Any parties raising a dispute are also required to simultaneously provide a copy of the dispute notice to the RIT-T proponent.

1 Introduction

This Project Assessment Conclusions Report (PACR) represents the final step of the RIT-T process[3] prescribed under the National Electricity Rules (the Rules) undertaken by Powerlink to address the condition risks arising from the ageing transformers, primary plant and secondary systems at Tarong and Chinchilla substations. It follows the publication of the Project Specification Consultation Report (PSCR) on 24 August 2021.

The Project Specification Consultation Report (PSCR):

- described the identified need that Powerlink is seeking to address, together with the assumptions used in identifying this need
- set out the technical characteristics that a non-network option would be required to deliver in order to address the identified need
- described the credible options that Powerlink considered may address the identified need
- discussed specific categories of market benefit that in the case of this RIT-T assessment are unlikely to be material
- presented the Net Present Value (NPV) economic assessment of each of the credible options (as well as the methodologies and assumptions underlying these results) and identified the preferred option
- noted that Powerlink was claiming an exemption from producing a Project Assessment Draft Report (PADR)
- invited submissions and comments, in response to the PSCR and the credible options presented, from Registered Participants, The Australian Energy Market Operator (AEMO), potential non-network providers and any other interested parties.

Powerlink identified Option 2, reconfiguring Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong by June 2025 as the preferred option to address the identified need. The Chinchilla to Tarong transmission line will be mothballed under this option. The indicative capital cost of the RIT-T project for the preferred option is $27.9 million in 2020/21 prices.

The Rules clause 5.16.4(z1) provides for a Transmission Network Service Provider to claim exemption from producing a PADR for a particular RIT-T application if all of the following conditions are met:

- the estimated capital cost of the preferred option is less than $46 million[4]
- the preferred option is identified in the PSCR noting exemption from publishing a PADR
- the preferred option, or other credible options, do not have a material market benefit, other than benefits associated with changes in involuntary load shedding[5]
- submissions to the PSCR did not identify additional credible options that could deliver a material market benefit.

There were no submissions received in response to the PSCR that closed for consultation on 22 November 2021. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation. As the conditions for exemption are now satisfied, Powerlink has not issued a PADR for this RIT-T.

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[3] This RIT-T consultation has been prepared based on the following documents: National Electricity Rules, Version 165, 27 May 2021 and AER, Application guidelines, Regulatory Investment Test for Transmission, August 2020.

[4] AER, *Costs threshold review for the regulatory investment tests 2018* in place at the commencement of this RIT-T consultation defined an exemption threshold of $43 million.

[5] Section 4.3 Project assessment draft report, Exemption from preparing a draft report, AER, *Application Guidelines, Regulatory investment test for transmission*, August 2020.

Subsequent to the publication of the PSCR, the risk cost analysis has been updated to reflect the AER's most recent Values of Customer Reliability (VCR) annual adjustment[6].The discount rate and sensitivities have also been adjusted. Consequently, the cost-benefit analysis has been updated to reflect these more recent parameters, which has not resulted in a change to the outcome of the economic analysis, ranking of options or identification of the preferred option under this RIT-T.

Powerlink is now publishing this PACR, which:

- describes the identified need and the credible options that Powerlink considers address the identified need
- discusses the consultation process followed for this RIT-T together with the reasons why Powerlink is exempt from producing a PADR
- provides a quantification of costs and reasons why specific classes of market benefit are not material for the purposes of this RIT-T assessment
- provides the results of the net present value (NPV) analysis for each credible option assessed, together with accompanying explanatory statements
- identifies the preferred option for investment by Powerlink and details the technical characteristics and proposed commissioning date of the preferred option.

2 Customer and non-network engagement

With five million Queenslanders and 236,000 Queensland businesses depending on Powerlink's performance, Powerlink recognises the importance of engaging with a diverse range of customers and stakeholders who have the potential to affect, or be affected by, Powerlink activities and/or investments. Together with our industry counterparts from across the electricity and gas supply chain, Powerlink has committed to The Energy Charter.

2.1 Powerlink takes a proactive approach to engagement

Powerlink regularly hosts a range of engagement forums and webinars, sharing effective, timely and transparent information with customers and stakeholders within the broader community. These engagement activities help inform the future development of the transmission network and assist Powerlink in providing services that align with the long-term interests of customers. Feedback from these activities is also incorporated into a number of publicly available reports.

2.2 Working collaboratively with Powerlink's Customer Panel

Powerlink's Customer Panel provides a face-to-face opportunity for customers and consumer representative bodies to give their input and feedback about Powerlink's decision making processes and methodologies. It also provides Powerlink with a valuable avenue to keep customers and stakeholders better informed, and to receive feedback about topics of relevance, including RIT-Ts.

The Customer Panel is regularly advised on the publication of Powerlink's RIT-T documents and briefed quarterly on the status of current RIT-T consultations, as well as upcoming RIT-Ts. This provides an ongoing opportunity for the Customer Panel to ask questions and provide feedback to further inform RIT-Ts, and for Powerlink to better understand the views of customers when undertaking the RIT-T consultation process.

2.3 Transparency on future network requirements

Powerlink's annual planning review findings are published in the Transmission Annual Planning Report (TAPR) and TAPR templates, providing early information and technical data to customers and stakeholders on potential transmission network needs over a 10-year outlook period. The TAPR plays an important part in planning Queensland's transmission network and helping to ensure it continues to meet the needs of Queensland electricity consumers and participants in the NEM.

[6] AER Values of Customer Reliability adjusted for 2021.

In addition, beyond the defined TAPR process, Powerlink's associated engagement activities provide an opportunity for non-network alternatives to be raised, further discussed or formally submitted for consideration as options to meet transmission network needs, well in advance of the proposed investment timings and commencement of regulatory consultations (where applicable).

2.3.1 Maintaining reliability of supply in Tarong and Chinchilla local areas

Powerlink identified in its 2018-2021 TAPRs, an expectation that action would be required to address the emerging reliability of supply issues in the South West transmission zone[7].

Powerlink advised members of its Non-network Engagement Stakeholder Register (NNESR) of the publication of the TAPR.

No submissions proposing credible and genuine non-network options have been received from prospective non-network solution providers in the normal course of business, in response to the publication of the TAPR or as a result of associated stakeholder engagement activities.

2.4 Powerlink applies a consistent approach to the RIT-T stakeholder engagement process

Powerlink undertakes a considered and consistent approach to ensure an appropriate level of stakeholder engagement is undertaken for each individual RIT-T. Please visit Powerlink's website for detailed information on the types of engagement activities that may be undertaken during the consultation process. These activities focus on enhancing the value and outcomes of the RIT-T process for customers, stakeholders and non-network providers. Powerlink welcomes feedback from all stakeholders to further improve the RIT-T stakeholder engagement process.

2.5 The transmission component of electricity bills

Powerlink's contribution to electricity bills reduced is approximately 9% of the total cost of the residential electricity bill (refer to Figure 2.1).

Figure 2.1: Components of end user bills

Detailed information on transmission pricing, including discussion on how Powerlink is actively engaging with customers and stakeholders on transmission pricing concerns, is available on Powerlink's website.

3 Identified need

This section provides an overview of the existing supply arrangements at Tarong and Chinchilla substations and describes the increasing risk to Powerlink of being unable to maintain compliance with relevant standards, applicable regulatory instruments and the Rules, designed to ensure Powerlink's customers continue to receive safe, reliable and cost effective electricity services.

3.1 Geographical and network overview

Tarong Substation was commissioned in 1982 and forms part of the 275kV backbone servicing South East Queensland, as well as local loads in the Chinchilla and Tarong areas. Chinchilla Substation was commissioned in 1986 to supply bulk electricity to the distribution network in the area, via a double circuit 132kV transmission line from Tarong Substation. In 2014, Powerlink established a new 275kV substation at Columboola as part of an expanded Surat Basin North West area transmission network. This new 275kV substation provided additional support to the existing 132kV Columboola Substation, and in turn to Chinchilla.

[7] This relates to the standard geographic definitions (zones) identified within the TAPR.

Planning studies have confirmed there is a long-term requirement to continue to supply the existing electricity services currently provided by the Tarong and Chinchilla substations. With peak demand forecast to remain steady in the area for the next ten years[8], it is vital that supply is maintained to satisfy this demand, and for Powerlink to meet its reliability of supply obligations.

The locations of the substations are shown in Figures 3.1.1 and 3.1.2.

Figure 3.1.1: South West area network

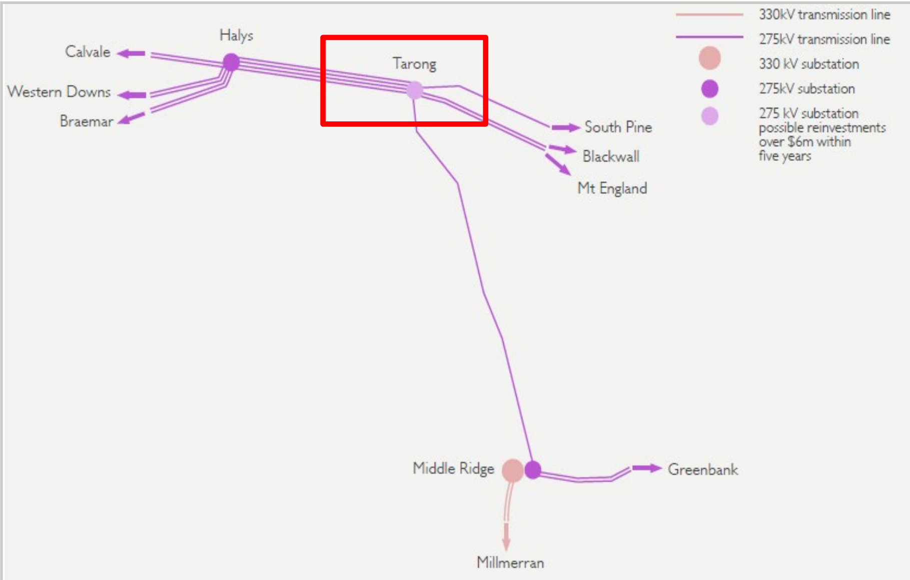
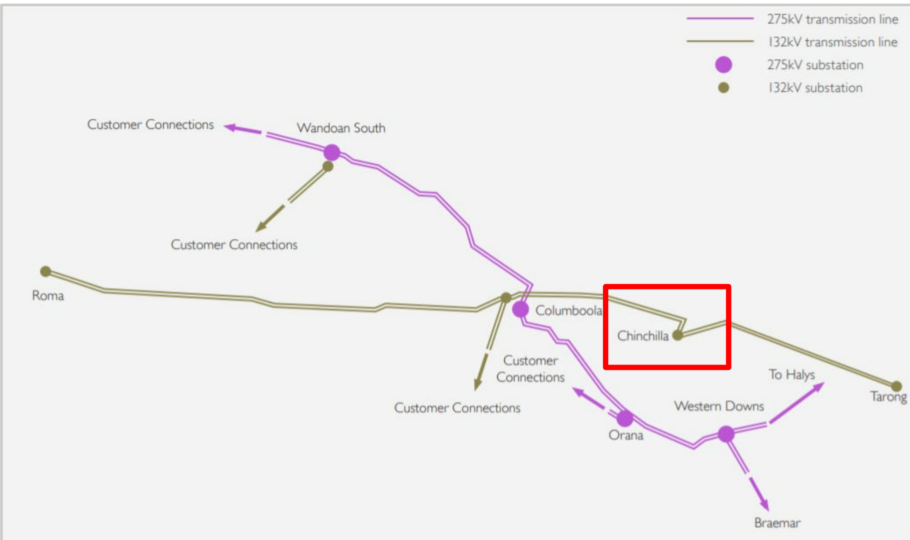


Figure 3.1.2: Surat Basin North West area transmission network



3.2 Description of identified need

There is a need for Powerlink to address the emerging risks from the ageing Tarong and Chinchilla assets to ensure ongoing compliance with the relevant standards and applicable regulatory instruments as well as Schedule 5.1 of the Rules, which are designed to ensure Powerlink's customers continue to receive safe, reliable and cost effective electricity services.

[8] Powerlink Transmission Annual Planning Report 2021

Powerlink's Transmission Authority requires it to plan and develop the transmission network "in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services". It allows load to be interrupted during a critical single network contingency, provided the maximum load and energy:

- will not exceed 50MW at any one time; or
- will not be more than 600MWh in aggregate[9].

Planning studies have confirmed that in order to continue to meet the reliability standard within Powerlink's Transmission Authority, the services currently provided by Chinchilla and Tarong Substations are required into the foreseeable future to meet ongoing customer requirements.

As the proposed investment is for meeting reliability and service standards arising from Powerlink's Transmission Authority and to ensure Powerlink's ongoing compliance with Schedule 5.1 of the Rules, it is a 'reliability corrective action' under the Rules[10].

A reliability corrective action differs from that of an increase in producer and consumer surplus (market benefit) driven need in that the preferred option may have a negative net economic outcome because it is required to meet an externally imposed obligation on the network business.

The identified need is described in greater detail in in the PSCR published in August 2021.

4 Submissions received

There were no submissions received in response to the PSCR that was open for consultation until the 22 November 2021[11]. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation.

5 Credible options assessed in this RIT-T

Powerlink has developed two credible network options to address the condition risks and compliance obligations at Tarong and Chinchilla substations.

Option 1: Replacement of all at-risk transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla by June 2025.

Option 2: Reconfigure Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong by June 2025. The Chinchilla to Tarong transmission line will be mothballed under this option.

A summary of the components of the two credible options is given in Table 5.1.

[9] Transmission Authority No. T01/98, section 6.2(c)
[10] The Rules, clause 5.10.2, Definitions, reliability corrective action
[11] Members of Powerlink's Non-network Engagement Stakeholder Register were also advised of the PSCR publication.

Table 5.1: Summary of credible options

Option	Description	Indicative capital cost ($m, 20/21)	Indicative annual O&M costs ($m, 20/21)
Maintain existing network topology			
Option 1: Replace all at-risk assets like-for-like by June 2025	Replace selected primary plant and all secondary systems at Chinchilla by June 2025*	13.38	0.14
	Replace four transformers and selected primary plant at Tarong by June 2025*	29.50	
	Refit Tarong to Chinchilla transmission line by 2035†	49.44	
Reconfigure network topology			
Option 2: Reconfigure Chinchilla and replace selected assets by June 2025	Replace selected primary plant and secondary systems at Chinchilla by June 2025*	10.06	0.16
	Replace two transformers and selected primary plant at Tarong by June 2025*	17.84	
	Decommission Chinchilla transformer bays at Tarong by 2026†	3.76	
	Mothball Tarong to Chinchilla transmission line by 2026†	3.00	
	Decommission the Tarong to Chinchilla transmission line by 2040†	23.43	

* Proposed RIT-T capital project
† Modelled capital and operational projects

Both credible options address the major risks resulting from the deteriorated condition of ageing and obsolete assets at Tarong and Chinchilla substations to allow Powerlink to meet its reliability of supply and safety obligations under applicable jurisdictional instruments and Schedule 5.1 of the Rules. Powerlink is the proponent of both credible network option presented.

None of these options has been discussed by the Australian Energy Market Operator (AEMO) in its most recent Integrated System Plan (ISP).[12]

5.1 Material inter-network impact

Powerlink does not consider that any of the credible options being considered will have a material inter-network impact, based on AEMO's screening criteria[13].

6 Materiality of market benefits

The rules require that all categories of market benefits identified in relation to a RIT-T be quantified, unless the TNSP can demonstrate that a specific category is unlikely to be material.

[12] Clause 5.16.4(b) (4) of the Rules requires Powerlink to advise whether the identified need and or solutions are included in the most recent ISP. The most recent ISP was published in July 2020

[13] In accordance with Rules clause 5.16.4(b)(6)(ii). AEMO has published guidelines for assessing whether a credible option is expected to have a material inter-network impact.

6.1 Market benefits that are material for this RIT-T assessment

Powerlink considers that changes in involuntary load shedding (i.e. the reduction in expected unserved energy) between options, set out in this PSCR, may impact the ranking of the credible options under consideration and that this class of market benefit could be material. These benefits have been quantified and included within the cost-benefit and risk-cost analysis as network risk.

6.2 Market benefits that are not material for this RIT-T assessment

The AER has recognised a number of classes of market benefits may not be material in the RIT-T assessment and so do not need to be estimated[14].

More information on consideration of individual classes of market benefits can be found in the PSCR.

7 Base Case

7.1 Modelling a Base Case under the RIT-T

Consistent with the RIT-T Application Guidelines the assessment undertaken in this PSCR compares the costs and benefits of credible options to address the risks arising from an identified need, with a Base Case[15].

As characterised in the RIT-T Application Guidelines, the Base Case itself is not a credible option to meet the identified need. Specifically, the Base Case reflects a state of the world in which the condition and obsolescence issues arising from the ageing assets are only addressed through standard operational activities, with escalating safety, financial, environmental and network risks.

To develop the Base Case, the existing condition and obsolescence issues are managed by undertaking operational maintenance only, which results in an increase in risk levels as the condition and availability of the asset deteriorates over time. These increasing risk levels are assigned a monetary value that is used to evaluate the credible options designed to offset or manage these risk costs.

The Base Case for the transformers, primary plant and secondary systems at Tarong and Chinchilla, as well as the transmission line between Tarong and Chinchilla includes the costs of work associated with operational maintenance and the risk costs associated with the failure of the assets. The costs associated with equipment failures are modelled in the risk cost analysis and are not included in the operational maintenance costs.

The Base Case acts as a benchmark and provides a clear reference point in the cost-benefit analysis to compare and rank the credible options against each other over the same timeframe.

7.2 Tarong - Chinchilla Base Case risk costs

Powerlink has developed a risk modelling framework consistent with the RIT-T Application Guidelines and the AER Industry practice application note[16]. An overview of the framework is available on Powerlink's website[17] and the principles of the Framework have been used to calculate the risk costs of the Base Case. The framework includes the modelling methodology and general assumptions underpinning the analysis.

[14] AER, Application guidelines, Regulatory investment test for transmission, December 2018
[15] AER, Application Guidelines, Regulatory Investment Test for Transmission, August 2020.
[16] AER Industry practice application note, Asset Replacement Planning, January 2019
[17] The risk costs are calculated using the principles set out in the Powerlink document, Overview of Asset Risk Cost Methodology, May 2019

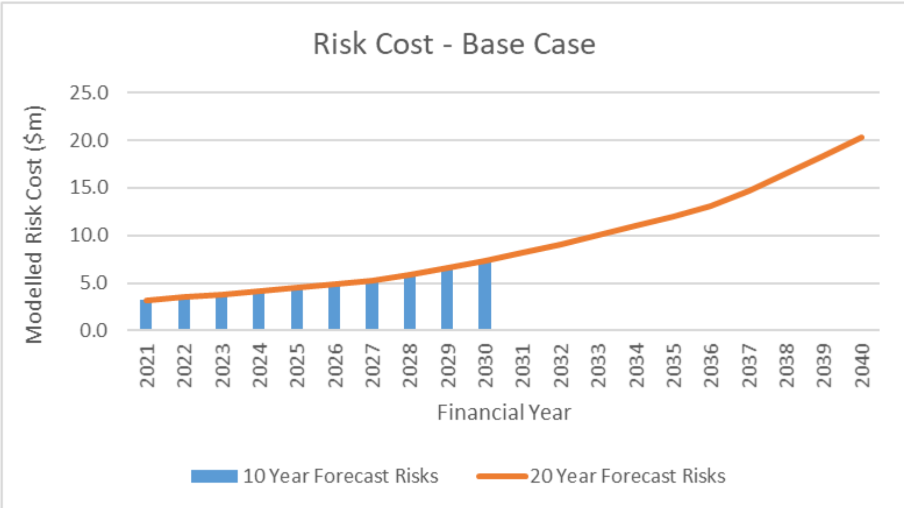
7.3 Base Case assumptions

In calculating the potential unserved energy (USE) arising from a failure of the ageing and obsolete assets at Tarong and Chinchilla substations, the following modelling assumptions have been made:

- Spares for secondary system items have been assumed to be available prior to the point of forecast spares depletion. After this point, the cost and time to return the secondary system back to service increases significantly.
- Historical load profiles have been used when assessing the likelihood of unserved energy under concurrent failure events.
- Peak demand for the greater Tarong and Chinchilla load areas consistent with medium demand forecasts published within Powerlink's 2020 Transmission Annual Planning Report have been used.
- Unserved energy generally accrues under concurrent failure events, and consideration has been given to potential feeder trip events within the wider area.
- The network risk cost models have used the weighted average of residential, agricultural and commercial load types within the relevant climate zone VCR published within the AER Value of Customer Annual Adjustment updated in 2021 ($26,446/MWh).

The 20-year forecast of risk costs for the Base Case is shown in Figure 7.3.1.

Figure 7.3.1: Modelled Base Case risk costs



Based upon the assessed condition of the ageing assets at Chinchilla and Tarong, the total risk costs are projected to increase from $3.5 million in 2022 to $22.2 million in 2041. The main areas of risk cost are associated with network risks that arise through failure of the deteriorated secondary systems modelled as probability weighted unserved energy[18], and financial risk costs associated mainly with the replacement of failed assets in an emergency manner. These risks increase over time as the condition of equipment further deteriorates, more equipment becomes obsolete and the likelihood of failure rises.

7.4 Modelling of Risk in Options

Each option is scoped to manage the key risks arising in the Base Case and to maintain compliance with all statutory requirements, the Rules and AEMO standards. The residual risk is calculated for each option based upon the individual implementation strategy of the option. This is included with the capital and operational maintenance cost of each option to develop the NPV inputs.

[18] Unserved Energy is modelled using a Value of Customer Reliability (VCR) consistent with that published by AER in their *Value of Customer Reliability Annual Adjustment (updated in 2021)*.

8 General modelling approach adopted for net benefit analysis

8.1 Analysis period

The RIT-T analysis has been undertaken over 20-year period, from 2022 to 2041. A 20-year period takes into account the size and complexity of the transformer replacement options.

There will be remaining asset life by 2041, at which point a terminal value is calculated to correctly account for capital costs under each credible option.

8.2 Discount rate

Under the RIT-T, a commercial discount rate is applied to calculate the NPV of the costs and benefits of credible options. Powerlink has adopted a real, pre-tax commercial discount rate of 5.5%[19] as the central assumption for the NPV analysis presented in this report.

Powerlink has tested the sensitivity of the results to changes in this discount rate assumption, and specifically to the adoption of a lower bound discount rate of 2.2%[20] and an upper bound discount rate of 8.8% (i.e. a symmetrical upwards adjustment).

8.3 Description of reasonable scenarios and sensitivities

The RIT-T analysis is required to incorporate a number of different reasonable scenarios, which are used to estimate market benefits and rank options. The number and choice of reasonable scenarios must be appropriate to the credible options under consideration and reflect any variables or parameters that are likely to affect the ranking of the credible options, where the identified need is reliability corrective action[21].

Based upon the minor differences between the options in terms of operational outcomes, Powerlink has chosen to present a single reasonable scenario for comparison purposes.

The detailed market modelling of future generation and consumption patterns required to assess alternative scenarios relating to connection of renewable generation represents a disproportionate cost in relation to the scale of the proposed network investment.

Notwithstanding this, Powerlink has considered capital cost, discount rate and risk cost sensitivities individually and in combination and found that none of the parameters has an impact on ranking of results. Hence, Powerlink has chosen to present a central scenario, as illustrated in Table 8.1.

Table 8.1: Reasonable scenario assumed

Key parameter	Central scenario
Capital cost	100% of baseline capital cost estimate
Discount rate	5.5%
Maintenance cost	100% of baseline maintenance cost estimate
Risk Cost	100% of baseline risk cost forecast

9 Cost benefit analysis and identification of the preferred option

9.1 NPV Analysis

Table 9.1. outlines the NPV and the corresponding ranking of each credible option relative to the Base Case.

[19] This indicative commercial discount rate of 5.5% is based on AEMO 2021 Inputs, Assumptions and Scenarios Report, p105.
[20] A discount rate of 2.2% pretax WACC is based on AER 2023-27 Powerlink Queensland revised revenue proposal, p21.
[21] AER, Regulatory investment test for transmission, August 2020, Section 23.

Table 9.1: NPV of credible options relative to Base Case

Option	Central scenario NPV relative to base case ($million, 2020/21)	Ranking
Option 1 Replace all at-risk assets like-for-like by June 2025	40.0	2
Option 2: Reconfigure Chinchilla and replace selected assets by June 2025	55.6	1

Both credible options will address the identified need on an enduring basis. Option 2 is ranked first with a net benefit of $55.6 million compared to the Base Case, with Option 1 resulting in $15.6 million less net benefit compared to Option 2.

Figure 9.1.1 sets out the breakdown of capital cost, operational maintenance cost and total risk cost for each option in NPV terms under the central scenario. Note that the non-credible Base Case consists of operational maintenance and total risk costs and does not include any capital expenditure.

Figure 9.1.1: Present value of Base Case and credible network options

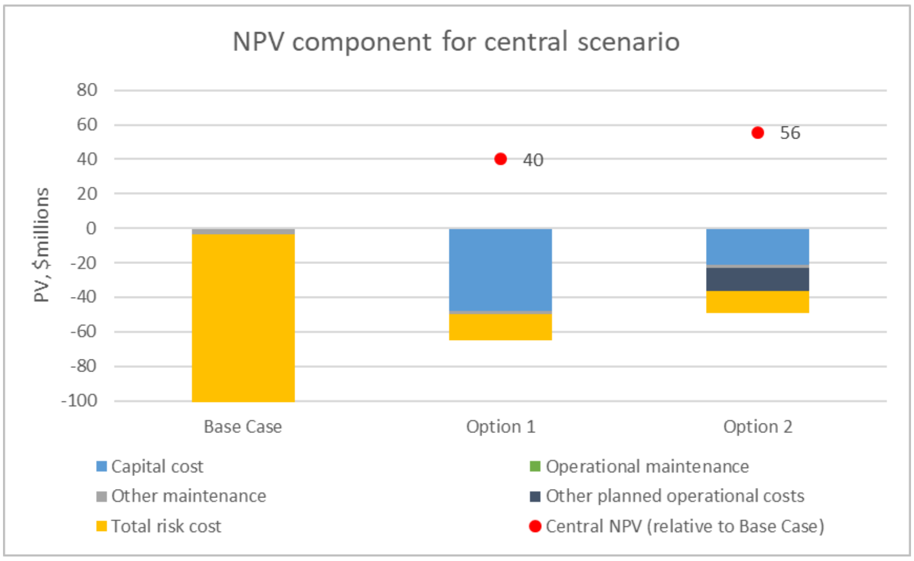


Figure 9.1.1 shows that both credible options significantly reduce risk cost relative to the Base Case and result in positive NPV relative to Base Case. Option 1 provides the greatest reduction in risk costs, but at higher capital cost, while Option 2 provides the highest net economic return relative to the Base Case of the two credible options.

9.2 Sensitivity analysis

Powerlink has investigated the following sensitivities on key assumptions:

- a range from 2.2% to 8.8% discount rate.
- a range from 75% to 125% of base capital expenditure estimates.
- a range from 75% to 125% of base maintenance expenditure estimates.
- a range from 75% to 125% of total risk cost estimates.

As illustrated in Figure 9.2.1 to Fig 9.2.4, sensitivity analysis for the NPV relative to the Base Case shows that varying the discount rate, capital expenditure, operational maintenance expenditure and total risk costs has no impact on the preferred option. Option 2 has the highest NPV under all sensitivities tested.

Figure 9.2.1 Discount Rate Sensitivity

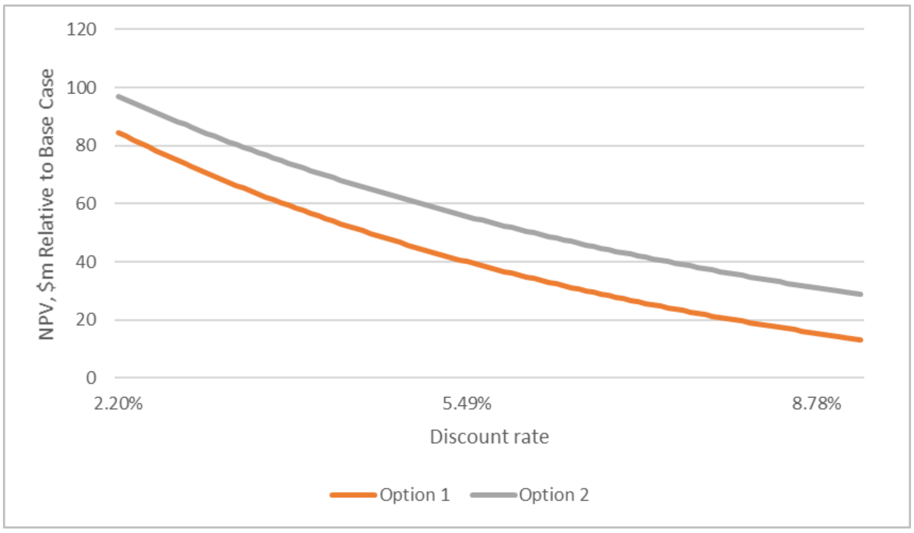


Figure 9.2.2 Capital cost sensitivity

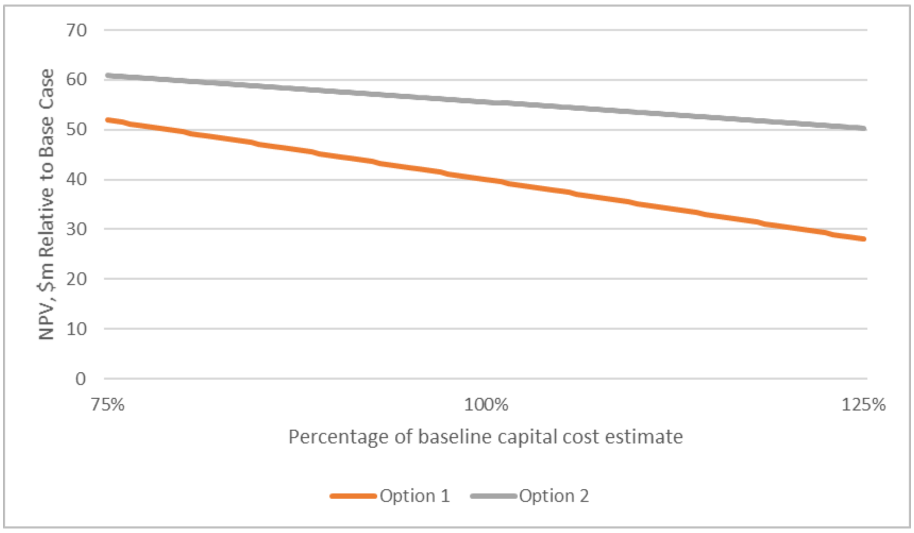


Figure 9.2.3 Maintenance cost sensitivity

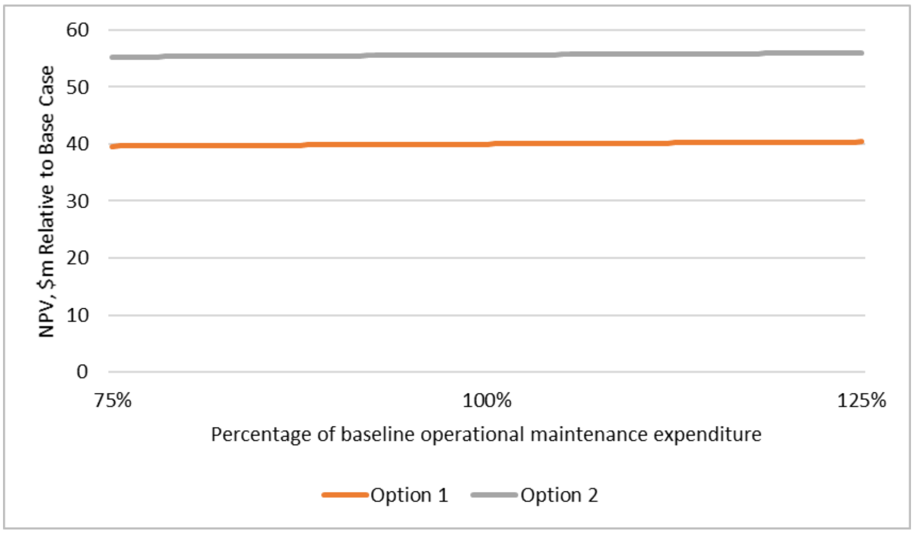
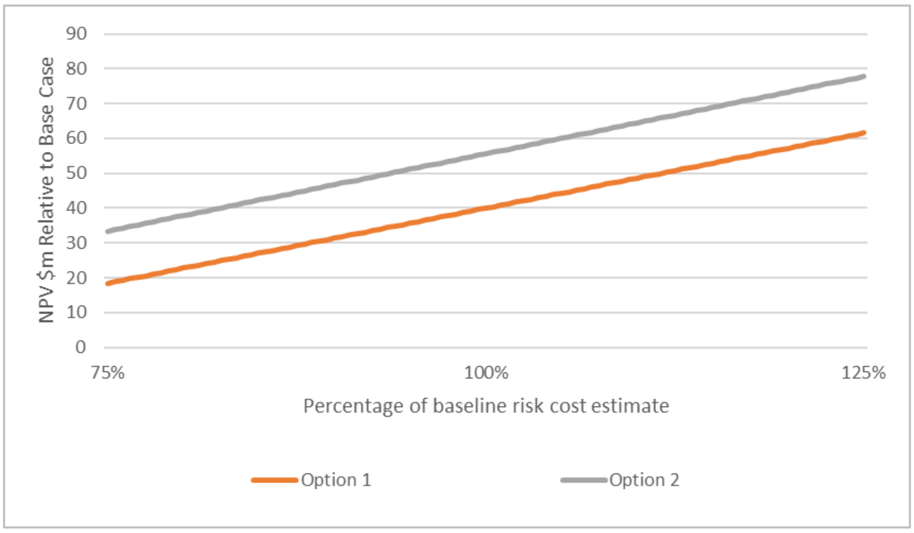


Figure 9.2.4 Risk cost sensitivity



9.3 Sensitivity to multiple parameters

A Monte Carlo simulation was performed with multiple input parameters (including capital cost, discount rate, operational maintenance cost and total risk cost) for the calculation of the NPV of each option. This process was repeated, in this case with over 5000 iterations, each time using a different set of random variables from the probability function. The sensitivity analysis output is presented as a distribution of possible NPVs for each option, as illustrated in Figure 9.3.1.

The results of the Monte Carlo simulation, identifies that Option 2 has less statistical dispersion in comparison to Option 1. The mean and median Option 2 is also the higher of the two options. This confirms that the preferred option, Option 2, is robust over a range of input parameters in combination.

Figure 9.3.1 NPV sensitivity analysis of multiple key assumptions relative to the Base Case

10 Preferred option

Based on the conclusions drawn from the economic analysis and the Rules requirements relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the risks arising from the deteriorated condition of the aged transmission assets at Tarong and Chinchilla Substation. Implementation this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the Rules.

The result of the economic analysis indicates that Option 2 is the credible option with the lowest cost to customers, in NPV terms, over the 20-year analysis period. Sensitivity testing shows the analysis is robust to variations in the capital cost, operational maintenance cost, risk cost and discount rate assumptions. Option 2 is therefore considered to satisfy the requirement of the RIT-T and is the preferred option.

11 Conclusion

The following conclusions have been drawn from the analysis presented in this report:

- Powerlink has identified condition risks arising from the condition risks of the transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla Substation as requiring action.
- Powerlink's is required to meet its obligations under the *Electrical Safety Act and Regulations, Work Health and Safety Act* and *Environmental Protection Act*, as well as its service standards under the *Electricity Act* and *Regulations and its Queensland Transmission Authority*.
- Studies were undertaken to evaluate two credible options. Both options were evaluated in accordance with the AER's RIT-T.
- Powerlink published a PSCR in August 2021 requesting submissions from Registered Participants, AEMO and interested parties on the credible options presented, including alternative credible non-network options, which could address the condition risks of the transformers and primary plant at Tarong and Chinchilla substations and secondary systems at Chinchilla Substation.
- The PSCR also identified the preferred option and that Powerlink was adopting the expedited process for this RIT-T, claiming exemption from producing a PADR as allowed for under the Rules Clause 5.16.4(z1) for investments of this nature.
- There were no submissions received in response to the PSCR, which was open for consultation until 22 November 2021. As a result, no additional credible options that could deliver a material market benefit have been identified as part of this RIT-T consultation. The conditions specified under the Rules for exemption have now been fulfilled.
- The result of the cost-benefit analysis under the RIT-T identified that Option 2 provides the greatest net economic benefit over the 20-year analysis period. Sensitivity testing showed the analysis is robust to variations in discount rate, capital expenditure, operational maintenance expenditure and risk costs assumptions. As a result, Option 2 is considered to satisfy the RIT-T.
- The outcomes of the cost-benefit analysis contained in this PACR remain unchanged from those published in the PSCR. Consequently, the draft recommendation has been adopted without change as the final recommendation and will now be implemented.

12 Final Recommendation

Based on the conclusions drawn from the NPV analysis and the Rules requirement relating to the proposed replacement of transmission network assets, it is recommended that Option 2 be implemented to address the risks associated with deteriorated condition of the ageing transmission assets at Tarong and Chinchilla substations. Implementing this option will also ensure ongoing compliance with relevant standards, applicable regulatory instruments and the Rules. Powerlink is the proponent of this option.

Option 2 involves reconfiguring Chinchilla Substation such that supply is from the Surat Basin network, by replacing selected primary plant and secondary systems, and replacing only two of the four transformers at Tarong by June 2025. The Chinchilla to Tarong transmission line will be mothballed under this option. The indicative capital cost of the RIT-T project for the preferred option is $27.9 million in 2020/21 prices.

Option 2 delivers additional benefit in that it provides for the potential connection of renewable generation in the area by preserving the option for the potential re-use of a section of the existing easement between Tarong and Chinchilla for the construction of a 275kV line from Halys Substation, should the need arise.

Under this option design work will commence in 2023, with all work completed by 2025. Powerlink will now proceed with the necessary processes to implement this recommendation.

Contact us

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Project Scope Report

CP.02170

Chinchilla Substation Replacement

Version 9

Document Control

Change Record

Issue Date	Responsible Person	Objective Document Name	Background
24/01/2020	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Initial version
12/02/2020	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	V2 Scope clarification
16/03/2020	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Add dual OPGW Chinchilla Columboola
29/09/2022	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Stage 2 Scope
22/08/2023	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Revised Stage 2 Scope– add bus & CB's
28/11/2024	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Revised Section 4.1.3 and 7.
24/07/2025	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Revised primary plant scope of works – minor
21/08/2025	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Removed Isolator 4117 from scope
03/09/2025	[redacted]	Project Scope Report CP.02170 Chinchilla Substation Replacement	Estimate requirement increased from class 3 to class 2.

Related Documents

Issue Date	Responsible Person	Objective Document Name
23/05/2019	[redacted]	PIF selective primary plant replacement T013 Chinchilla (A3077853)
28/10/2019	[redacted]	T013 Chinchilla Condition Assessment (A3155032)

Issue Date	Responsible Person	Objective Document Name
13/08/2019	[redacted]g	PIF - T013 Chinchilla Secondary System Replacement - Project initiation Form (A3166088)
25/07/2019	[redacted]	T013 Chinchilla Secondary System Condition Assessment Report July 2019 (A3165342)
17/7/2019	[redacted]	Chinchilla Substation Civil Condition Assessment Report (A3158770)

Project Contacts

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

Project Details

1. Project Need & Objective

Chinchilla Substation is a 132/110/33kV substation in the Surat Basin North West Area, approximately 80km west of Dalby. The substation was built in 1984 and was originally operated by Ergon. A selection of primary plant assets (CBs, CTs, CVTs, disconnectors and earth switches) will reach the end of technical asset life by 2024. In addition, a condition assessment of the secondary systems has concluded that the majority of the common service secondary systems will reach the end of its technical asset life by 2022.

Note that the 3T HV CB bay assets will be transferred from Energy Queensland (EQ) to Powerlink (PQ), facilitating PQ metering compliance, operational switching requirements, and a consistent asset boundary.

The objective of this project is the replacement of selected primary plant and secondary systems at Chinchilla Substation by 2026.

2. Project Drawings

[redacted]

Figure 2 T013 Chinchilla Proposed Operating Diagram

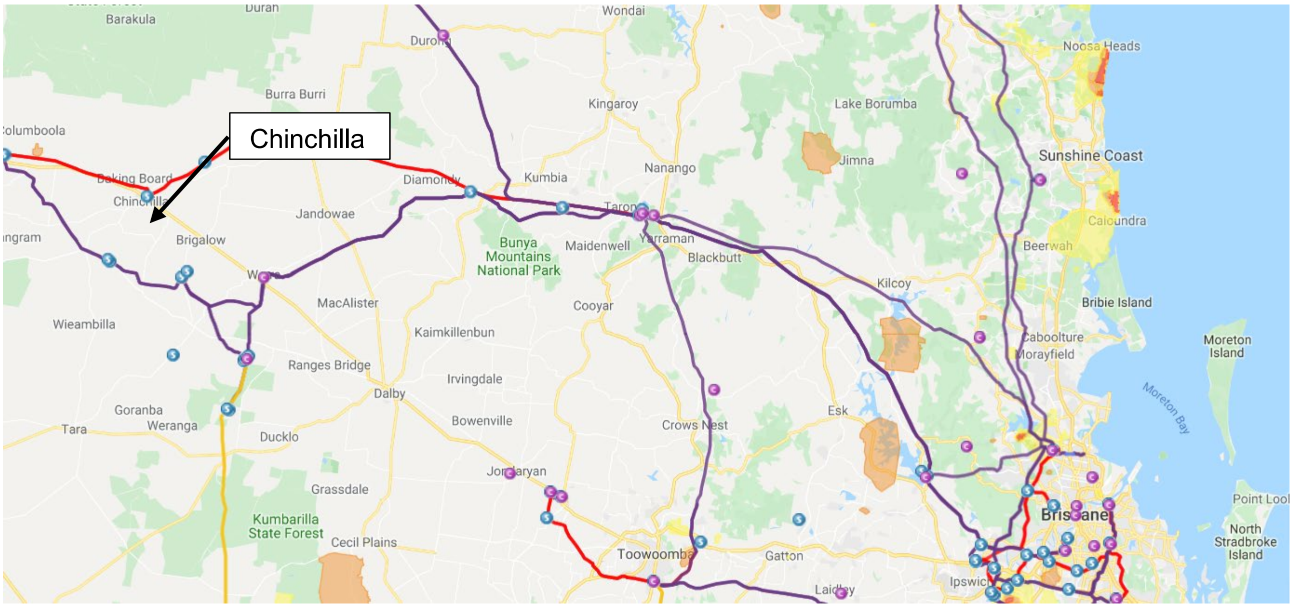

Figure 3 Chinchilla Site Locality Map

3. Deliverables

The following deliverables must be provided in response to this Project Scope Report:

1. A report (e.g. Project Proposal) detailing the works to be delivered, proposed staging of delivery, confirmed resource requirements and outages
2. A class 2 estimate (minimum), based upon published design advices detailing key design elements, including contractor pricing and verified MSP costs
3. A basis of estimate document and risk table, detailing the key estimating assumptions and delivery risks
4. A detailed project staging and outage plan that includes primary plant, secondary systems and telecoms outages
5. A Division of Responsibility document for regulated connection works involving existing customer, as set out in section 11 of this document.

4. Project Scope

4.1. Original Scope

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

Briefly, the project consists of the replacement of selected primary plant and secondary systems. Refer Figures 1 and 2.

4.1.1. Transmission Line Works

Mothballing of BS2412 comprising Tarong – Chinchilla Feeders 7168 and 7183 is addressed under project CP.02858 Darling Downs REZ and has been removed from the scope of this project.

Installation of the dual OPGW on BS2413 Columboola to Chinchilla (Feeders 7349 and 7350) has been completed under CP.02742 Blue Grass Connection and has been removed from the scope of this project.

4.1.2. T013 Chinchilla Primary Plant Works

The scope of substation works at Chinchilla includes the decommissioning of Spare 6 Bay (D03, previously Tarong feeder 7168) including landing span back to a practical point on the feeder and secure and Spare 5 Bay (D05, previously Tarong feeder 7183) including landing span back to a practical point on the feeder, isolator 4117, 7349 (D03 Columboola Bay) and 7350 (D04 Columboola Bay). Rebuild 4T bay D01 as a radial feeder bay. Upgrade 3T bay to a radial feeder bay arrangement.

Within the scope of work, design, procure, construct and commission replacement of the remaining primary plant as follows:

- Replacement of the transformer bay D01 (4T) CB, CTs and CVT's including structures and foundations;
- Refurbishment remaining disconnectors and earth switches. Removal of disconnector 4117;
- Dismantle and remove the incoming spans to the decommissioned Tarong feeders and recover all redundant equipment, and update drawing records, SAP records, config files, etc. accordingly.

4.1.3. T013 Chinchilla Secondary Systems Works

The scope of substation works at Chinchilla includes the decommissioning of Spare 6 Bay (D03, previously Tarong feeder 7168) and Spare 5 Bay (D05, previously Tarong feeder 7183), 7349 (D03 Columboola Bay) and 7350 (D04 Columboola Bay). Rebuild 4T bay D01 as a radial feeder bay. Upgrade 3T bay such that it functions as a radial feeder bay and replacement of the remaining secondary systems. Note that the 3T bay will become a Powerlink asset.

Within the scope of work, design, procure, construct and commission replacement of the secondary systems as follows:

- Replace all marshalling kiosks and associated VT box for Transformer 3 & 4;
- Replace 1 & 2 Bus, and Transformer 3 and 4 bay secondary systems including protection and control panels, new HMI, and OpsWAN;
- Remove 1 & 2 Bus secondary systems including related panel equipment;
- Provide a dedicated Powerlink SCADA system based on DNP/IP;
- Provide timing clock for Powerlink secondary systems;
- Investigate auxiliary power requirements;
- Review existing AC and DC arrangement and provide Powerlink AC and DC Supply systems as required;
- Install new cabling from the new control building to the marshalling kiosks;
- Replace all metering as necessary;
- Decommission and recover all redundant equipment, and update drawing records, SAP records, config files, etc. accordingly.

4.1.4. T194 Columboola Remote End Secondary Systems Works

Modify protection, control, automation and communications systems for feeders 7349/1 and 7350/1 compatible with new secondary systems at Chinchilla as necessary.

4.1.5. T268 Cameby Remote End Secondary Systems Works

Modify protection, control, automation and communications systems for feeders 7349/3 and 7350/3 compatible with new secondary systems at Chinchilla as necessary.

4.1.6. Telecoms Works

Modify telecommunications equipment as necessary to meet the requirements of the new secondary systems (SDM9.2) at Chinchilla as necessary including removal of the associated PLC's.

4.1.7. Easement/Land Acquisition & Permits Works

Easement rights and approvals must be considered with the Property team.

Not applicable

4.2. Key Scope Assumptions

Not applicable.

4.3. Variations to Scope (post project approval)

Not applicable

5. Key Asset Risks

The secondary systems condition profiles recommend the preferred staging of secondary systems removal/replacement in the following order:

- 132kV 1 & 2 Bus
- Feeders 7349 and 7350
- Metering

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

6. Project Timing

6.1. Project Approval Date

The anticipated date by which the project will be approved is 28 February 2026.

6.2. Site Access Date

Chinchilla Substation is an existing Powerlink site; access is already available. Ergon do have assets at the site.

6.3. Commissioning Date

The latest date for the commissioning of the new assets included in this scope is 31 December 2027, including decommissioning and removal of redundant assets where applicable.

7. Special Considerations

Consideration should be given to:

- Staging of the replacement works; potentially using the spare bays previously landing the Tarong –Chinchilla feeder to minimise outage durations;
- Replacement of the disconnectors where refurbishment is not feasible;
- It is preferred to remove all Powerlink assets form the existing control building. Ensure all Powerlink assets are established or relocated to the new control building.
- Marshalling Kiosks and Panels found to be upgraded on previous projects may be reused if found to be of suitable condition.

8. Asset Management Requirements

Equipment shall be in accordance with Powerlink equipment strategies.

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

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

9. Asset Ownership

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

The asset boundary with Energy Queensland will be at the HV terminals of Transformer 3 (132/33kV) and Transformer 4 (132/110kV).

10. System Operation Issues

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

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

11. Options

Not applicable

12. Division of Responsibilities

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

13. Related Projects

Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
Co-requisite Projects			
CP.02584	Tarong Transformer Replacement	2026	
OR.02325	H018 Tarong 1T and 4T Transformer Decommissioning	2025	
Other Related Projects			

CP.02170 Chinchilla Substation Replacement

Concept Estimate

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1. Executive Summary

This concept estimate has been developed based on the CP.02170 Chinchilla Substation Replacement PSR.

Chinchilla Substation is a 132/110/33kV substation in the Surat Basin Northwest Area, approximately 80km west of Dalby. The substation was built in 1984 and was originally operated by Ergon. A selection of primary plant assets (CBs, CTs, CVTs, disconnectors and earth switches) will reach the end of technical asset life by 2024. In addition, a condition assessment of the secondary systems has concluded the majority of the common service secondary systems will reach the end of its technical asset life by 2022.

The 3 Transformer HV CB bay assets will be transferred from Energy Queensland (EQ) to Powerlink (PQ), facilitating PQ metering compliance, operational switching requirements, and a consistent asset boundary.

The objective of this project is the replacement of selected primary plant and secondary systems at Chinchilla Substation by 2026 (PSR requested date). *The assessment behind this proposal has established that the project can be delivered by December 2027.*

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)		16,565,384
TOTAL		**16,565,384**

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 2026	4,717,627
To June 2027	8,911,380
To June 2028	2,852,861
To June 2029	83,516
TOTAL	**16,565,384**

2. Project and Site-Specific Information

2.1 Project Dependencies & Interactions

This project is related to the following projects:

Project No.	Project Description	Planned Commissioning Date	Comment
Interactions			
CP.02771	Telecommunications Network Consolidation RAN1	November 2025	SDH and PDH Multiplexer replacement program.
CP.02512	OpsWAN and MPLS Replacement RAN1	June 2026	OpsWAN and MPLS Router replacement program.

2.2 Site Specific Issues

- T013 Chinchilla Substation is located at 51 Cemetery Road, Chinchilla.
- The substation consists of one yard of 132kV equipment and an Energy Queensland 33kV distribution system. Powerlink's 132kV protection and control systems are housed in an existing building, (shared with Energy Queensland protection and control systems) adjacent to the switchyard.
- The Miles area is subject to the following average number of days of rain. Consideration was given to this when developing the project schedule.

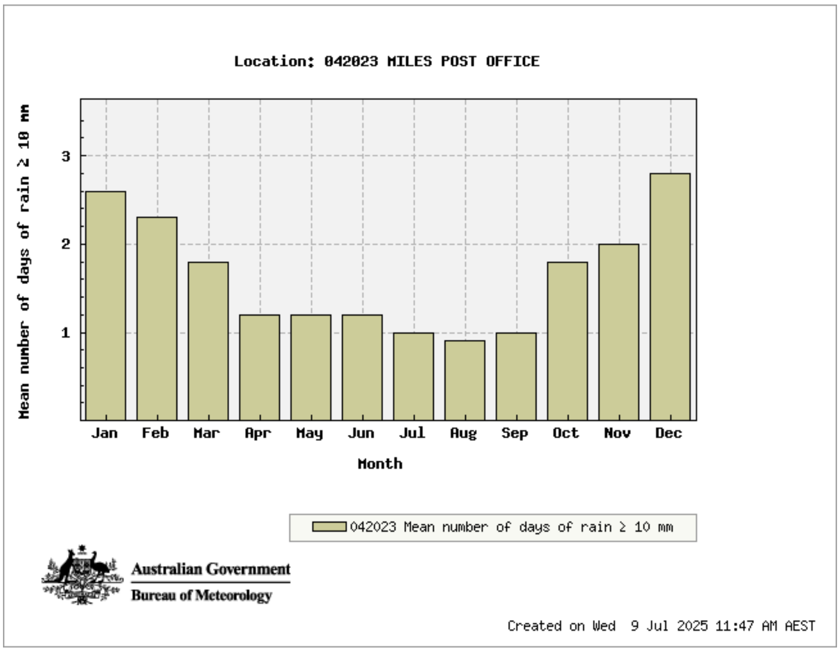

Figure 1 - Number of Days of Rain >10mm Miles (Source: Bureau of Meteorology 9th July 2025)

3. Project Scope

3.1 Substation Works

The scope of substation works at Chinchilla includes the decommissioning of Spare 6 Bay (D03, previously Tarong feeder 7168) including landing span back to a practical point on the feeder and Spare 5 Bay (D05, previously Tarong feeder 7183) including landing span back to a practical point on the feeder, isolator 4117, 7349 (D03 Columboola Bay) and 7350 (D04 Columboola Bay). Rebuild 4T bay D01 as a radial feeder bay. Upgrade 3T bay to a radial feeder bay arrangement. Note that the 3T bay will become a Powerlink asset.

T013 Chinchilla Primary Plant Works

Design, procure, construct and commission replacement of the remaining primary plant as follows:

- Replacement of the transformer bay D01 (4T) CB, CTs and CVT's including structures and foundations;
- Refurbishment remaining disconnectors and earth switches. Removal of disconnector 4117;
- Dismantle and remove the incoming spans to the decommissioned Tarong feeders and recover all redundant equipment.
- Update drawing records, SAP records, config files, etc. accordingly.

T013 Chinchilla Secondary Systems Works

Design, procure, construct and commission replacement of the T013 Chinchilla secondary systems equipment, including decommissioning of Spare 6 bay (D03, previously Tarong feeder 7168) and Spare 5 bay (D05, previously Tarong feeder 7183).

- Replace all marshalling kiosks and associated VT box for Transformer 3 & 4.
- Replace Transformer 3 and 4 bay secondary systems including protection and control panels, new HMI, and OpsWAN.
- Remove 1 & 2 Bus secondary systems including related panel equipment.
- Provide a dedicated Powerlink SCADA system based on DNP/IP.
- Provide timing clock for Powerlink secondary systems.
- Modification to the existing AC and DC arrangement as follows:
    - Installation of a new diesel generator.
    - Construction of new AC/DC marshalling kiosks.
- Install new cabling from the new control building to the marshalling kiosks.
- Installation of a new IP metering system.
- Coordinate modification of protection, control, automation and communications systems for Energy Queensland assets at T013 Chinchilla.
- Decommission and recover all redundant equipment.
- Update drawing records, SAP records, config files, etc. accordingly.

Remote Ends

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

- Feeders 7349/1 & 7350/1 from T194 Columboola Substation.
- Feeders 7349/3 & 7350/3 from T268 Cameby Substation.

[redacted]

Figure 3 - T013 Chinchilla Operating Diagram - Proposed Arrangement

3.2 Telecommunication Works

No new services are to be established under this project as the equipment has been moved to the new Control Building +6 previously. Redundant equipment will be decommissioned and removed from the existing Control Building +1.

3.3 Major Scope Assumptions

The following key assumptions were made for this Project Estimate.

- Minor Secondary Systems works only is expected to integrate the remote end substation with the new T013 Chinchilla Secondary Systems. All works at the remote end substations will be completed by MSP.
- Powerlink Internal Design teams will be used for the Primary, Secondary Systems and Telecommunications design work. It is envisaged external resources will be contracted by these teams to assist with resourcing or technical constraints.

- Estimate is based on Powerlink architectures, standards and equipment in place and available at the time of development.
- 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 to complete the works.
- Procurement of long lead items align with project delivery requirements.
- Energy Queensland design and construction resources will be available when required for remote end works. Timely agreement of Division of Responsibility (DOR) between Energy Queensland and Powerlink for all the works involved.
- Operational works permit will be granted.
- Contractor spoil can be spread on site adjacent to the substation pad.

The following assumptions have been made with respect the Primary Electrical design:

- Electric and magnetic field testing, studies and calculations are not required.

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

- Design standard of the new secondary systems will be of SDM9.2 for consistency with the existing SAS at T013 Chinchilla established under CP.02742.
- New relays considered for the upgrade of the remote sites will be suitable for the customer's needs and requirements.
- Existing secondary systems drawings are of a reasonable standard to allow design to progress without major upgrades.
- No changes to existing runback protection schemes.

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

- The existing substation platform and yard drainage system drains freely and is fit for purpose.
- Drainage for any new pits shall be provided into the existing drainage system or off the substation platform.
- The existing ground conditions are suitable for the construction of standard foundations.
- Allowance for partial below ground demolition of foundations and reinstatement of the substation ground cover.

3.4 Scope Exclusions

- Easement acquisitions work, including permits, approvals, development applications are excluded. All works are within Powerlink-owned land.
- No allowance is included for any Energy Queensland projects that may impact Powerlink works.
- No allowance is included for Energy Queensland design teams to provide design for the decommissioning of the existing metering panel.
- Additional time and cost for Design, Planning and Implementation of any restoration plans required for outages is not included in this estimate.
- Currency fluctuations between estimate date and date of equipment deliveries.
- No major modification to the earth grid is included in this estimate.
- Removal of rock or unsuitable material, including asbestos and other contaminants.
- This estimate does not include any costs for repairing or modification to the primary plants not listed to be replaced under the scope.

- No modification and upgrading of the internal roads, lights, fences and gates.
- No allowance has been made for the demolition and removal of the existing control building, as it is required for customer assets.
- No modification on the existing transmission lines or HV underground cables is considered in this estimate.
- No allowance has been made for Live substation works.
- Installation of helicopter landing pad.
- Modification or improvements to existing line access tracks.

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
Stage 1 Approval (PAN1) includes funds for design & procurement, & ITT preparation	June 2025 (*Received)*
Project Development Phase 1 & Phase 2	March 2026 – December 2026
ITT Submission	August 2026 – November 2026
Evaluate Tender, Reconcile Estimate and Submit PMP for Stage 2 Approval	November 2026
Stage 2 Approval (PAN2)	January 2027
Execute Delivery (including award of SPA contract)	February 2027
MSP Site Establishment	February 2027
Staged Bay Construction and Commissioning	February 2027 – September 2027
SPA Site Establishment	April 2027
SPA Civil Works and Construction	May 2027 – August 2027
Project Commissioning	September 2027
Decommissioning and Removal of Redundant Assets	September 2027 – December 2027

4.2 Network Impacts

Discussions with Network Operations have advised the following.

- Extended outages are available on both T194 Columboola feeders with reasonable return to service time.
- Return to service should be predicated on using FAM personnel and within 6 hours.

4.3 Resourcing

Design for the project will be completed by internal design resources with support from external design partners. 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	12,019,870	73
Substation Secondary Systems	3,965,806	24
Telecommunications	579,708	3
Overhead Transmission Line	-	0
TOTAL	**16,565,384**	**100**

6. References

Document name and hyperlink	Version	Date
Project Scope Report	9.0	3/09/2025