

2018-22

POWERLINK QUEENSLAND REVENUE PROPOSAL

Project Pack - PUBLIC

CP.02371

Bouldercombe Transformer 1 & 2 Replacement

© Copyright Powerlink Queensland 2016



Delivering better value



ID&TS - Reset 2017/18-2021/22 Project Proposal for CP.02371 H010 Bouldercombe No. 1 & 2 Transformer Replacement

Document Approval

	Name	Position
Prepared by		Project Manager
Reviewed by		Manager Projects
Approved by		Group Manager Infrastructure Delivery



Contents

1.	EXECUTIVE SUMMARY	3
2.	PROJECT DEFINITION	3
2.1	Project Scope.....	3
2.2	Major Scope Assumptions.....	4
2.3	Scope Exclusions.....	4
3.	PROJECT EXECUTION	4
3.1	Project Dependencies & Interactions.....	4
3.2	Site Specific Issues	5
3.3	Project Delivery Strategy.....	5
3.4	Proposed Sequence of Works.....	6
3.4.1	Project Schedule	6
3.4.2	Project Staging	6
3.4.3	Network Impacts and Outage Planning	6
3.5	Project Health & Safety	7
3.6	Project Environmental Management.....	7
4.	PROJECT RISK MANAGEMENT	7
5.	PROJECT ESTIMATE	7
5.1	Estimate Summary.....	7
5.2	Asset Disposal Table.....	8
6.	REFERENCES	9

1. Executive Summary

H010 Bouldercombe Substation was originally established in 1975 as a 275kV injection point into Central Queensland to supply the Ergon Energy distribution network in the region of Rockhampton. H010 Bouldercombe substation has three 275/132kV transformers 2 x 200MVA (Tx1 & Tx2) and one 375MVA unit established in 2012.

Tx1 & Tx2 were installed in 1976/77. The units are approaching 40 years of age and are displaying significant condition issues typical of transformers of this age.

The objective of this project is to replace both transformer 1 and transformer 2 with a single new 375MVA unit by June 2022.

2. Project Definition

2.1 Project Scope

Briefly, the project consists of replacing the existing 2 x 200MVA 275/132/19.1kV transformers at H010 Bouldercombe with a new single 275/132/19.1kV 240/300/375MVA transformer unit.

Decommission, remove and dispose of the recovered transformer 1 and transformer 2 units.

2.1.1 Transmission Line Works

Not applicable.

2.1.2 H010 Bouldercombe Substation works

Design, procure erect and commission 1 x 275/132/19.1kV 375MVA transformer, including all necessary civil works:

- Procure, supply and install 1 x 240/300/375MVA 275/132/19.1kV transformer, with on load tap changer and cooling facilities;
- Replace transformer 1 foundation;
- Replace existing Tx1 275/132/19.1kV 200MVA transformer unit with a single new 275/132/19.1kV 240/300/375MVA transformer unit;
- Decommission and recover 275/132kV 200MVA Tx2 and Station Services transformer Tx5 and associated plant, equipment and L/V cabling to AC changeover board;
- Upgrade 275 & 132kV landing spans, strung bus connections, and surge arrestors;
- Establish a new 500kVA station services transformer connected to 275/132/19.1KV Transformer 3 tertiary winding;
- Install suitably sized L/V Cabling from new station services transformer to the AC change over board;
- Upgrade associated bay plant equipment to achieve load rating compatible with new transformer ratings;
- Recover and dispose of old T1 and T2 transformer units;



- Modify protection, automation and communication systems as necessary to accommodate the new transformers;
- Outages are available for an in situ replacement.

2.2 Major Scope Assumptions

- The existing oil separation tank is suitable for reuse. A high level review has determined that the capacity is sufficient however the condition of the existing tank has not been assessed;
- It has been assumed that long duration outages will be available to allow in-situ replacement of the transformer.

2.3 Scope Exclusions

- Replacement of the existing oil separation tank

3. Project Execution

3.1 Project Dependencies & Interactions


Project No.	Project Description	Planned Comm Date	Comment
Pre-requisite Projects			
Co-requisite Projects			
CP.02350	Bouldercombe 132kV Primary Plant Replacement		CP.02350 includes the TF bay primary plant/CB replacement.
Other Related Projects			

3.2 Site Specific Issues

3.3 Project Delivery Strategy

It is expected that the project will be delivered using a Substation Panel Contractor under a Construct Only contract. Powerlink is expected to perform the design with the Maintenance Service Provider performing the testing and commissioning.

Project Delivery Strategy Matrix		
Design	Earthworks Design	Powerlink
	Civil Design	Powerlink
	Electrical Design (Primary)	Powerlink
	Electrical Design (Secondary) – Protection	Powerlink
	Electrical Design (Secondary) – Automation	Powerlink
	Transmission Line Design	N/A
	Telecommunication Design	Powerlink
Construction	Earthworks Construction	SPA Contractor
	Civil Construction	SPA Contractor
	Electrical Construction / Installation	SPA Contractor
	Transformer Delivery and Installation	TF Manufacturer
Testing	Substation Testing – FAT	SPA Contractor
	Substation Testing – SAT	MSP
	Substation Testing – Cut-Over	MSP

	ID&TS-PRG-RPT-A2307849	Version: 2.0
	ID&TS – Reset 2017/18-2021/22 Project Proposal for CP.02371 H010 Bouldercombe No. 1 & 2 Transformer Replacement	
	Telecommunication Testing	MSP

3.4 Proposed Sequence of Works

3.4.1 Project Schedule

To meet the required commissioning date of 30th June 2022 full project approval will be required by March 2020.

High Level Schedule

- Project Approval : March 2020
- TF Procurement : April 2020
- Design Complete : Dec 2020
- SPA Construct contract awarded : Feb 2021
- TF1 construction : April 2021 – Aug 2021
- TF1 testing/commissioning : Sept/Oct 2021
- Decommission TF2/Tidy up : March/June 2022
- Project Completion : 30th June 2022

3.4.2 Project Staging

Major project stages of the project are considered to be:

Stage	Description/Tasks
1	Non outage prep work.
2	Decommission, remove and dispose of old transformer 1 including transformer foundations. Construct new foundations and install new transformer followed by noise wall and blast wall including all associated electrical works.
3	Test and commission new transformer 1 and associated electrical works.
4	Decommission, remove and dispose of old transformer 2 and foundations including associated electrical plant and foundations as required.

3.4.3 Network Impacts and Outage Planning

Preliminary outage advice from Network Operations has indicated that outages will be difficult to obtain but available where an acceptable contingency plan can be prepared. For the purposed of this proposal is has been assumed that a long duration outage of TF1 will be available. The decommissioned TF1 may need to be retained on site during construction as a spare. The remaining two transformers are to remain in service. Work needs to be programmed during the lower load period of April to end Sept.



3.5 Project Health & Safety

The implications of relevant workplace health & safety legislation in delivering the proposed solution have been considered in preparing this estimate. In particular, this estimate includes an allowance for typical safety related activities required in the delivery phase of the project.

3.6 Project Environmental Management

No specific environmental management implications for the delivery of this project have been identified.

4. Project Risk Management

Some allowances have been allowed in the estimate. Please see estimate for details. Please refer to the assumptions and exclusion as these items have implications for the overall project risk.

5. Project Estimate

5.1 Estimate Summary

Quote Summary			
The quotation at current base level and escalated for completion by 30/06/2022 at 2.5% per year plus labour rate variations, for CP.02371 H010 Bouldercombe No.1 & 2			
CP.02371 Quotation in \$ AUD	Base Levels	Escalated to Compln.	Comment (Costs @ Base Levels)
H010 Bouldercombe Substation			Replace the existing 2 x 200MVA 275/132/19.1kV transformers at H010 Bouldercombe with a new single 275/132/19.1kV 240/300/375MVA transformer unit. Decommission, remove and dispose of the recovered transformer 1 and transformer 2 units. Replace existing transformer foundation. Decommission and recover 275/132kV 200MVA Tx2 and Station Services transformer Tx5 and associated plant, equipment and L/V cabling to AC changeover board. Establish a new 500kva station services transformer and install new LV cable connected to 275/132/19.1KV Transformer 3 tertiary winding. Install L/V cabling from new station services transformer to AC change over board. Upgrade as required 275 & 132kV landing spans, strung bus connections, and surge arrestors. Upgrade 132kV and 66kV Landing Spans. Modify protection and automation systems.
Project Management			
Qleave			
Other Costs			
TOTAL QUOTE (EXCL RISKS AND OFFSETS)	6,056,766	6,963,187	
Offsets Estimate	0	0	
TOTAL QUOTE (INCL OFFSETS)	6,056,766	6,963,187	
Climate			
Construction			
Design			
Risk Estimate	363,000	363,000	
TOTAL QUOTE (INCL RISKS AND OFFSETS)	6,419,766	7,326,187	



5.2 Asset Disposal Table

The current net book value of assets to be disposed of as a result of this project are set out in the table below.

CP.02371 Asset Disposal Table. Values current at 30th June 2016							
Functional Loc.	Description	Asset	Subnumber	Book val.	Disposal %	Disposal Value	Currency
H010-C02-541-	275kV 1 TRANSF BAY	104724	0	103,873.12	0%	\$ -	AUD
H010-C04-542-	275kV 2 TRANSF BAY	104736	0	573,801.64	100%	\$ 573,801.64	AUD
H010-SIN	SUBSTATION INFRASTRUCTURE	104776	0	1,239,447.05	0%	\$ -	AUD
H010-T01-1TRF	1 TRANSFORMER	104778	0	297,433.98	100%	\$ 297,433.98	AUD
H010-T02-2TRF	2 TRANSFORMER	104779	0	297,433.98	100%	\$ 297,433.98	AUD
Total						\$ 1,168,669.60	AUD



6. References

Document name and hyperlink (as entered into Objective)	Version	Date
Project Scope Report	1.0	June 2015
Estimate Detail	2.0	Jan 2016



H010 Bouldercombe Transformer T1 & T2 Condition Assessment

Report requested by:	[REDACTED]	Requested Completion Date:	30/10/2015
Report Prepared by:	[REDACTED]	Date of site visit:	11/06/2015
AUTHOR/S:	[REDACTED]		
Report Approved by:	[REDACTED]	Report Approval Date:	
Report Reviewed by:	[REDACTED]	Review Date:	31/12/2015
Issue Approved by:	[REDACTED]	Issue Date:	

Date	Version	Objective ID	Nature of Change	Author	Authorisation
13/10/2015	1.0	A2374963	Original issue	[REDACTED]	
31/12/2015	2.0	A2420310	Small modifications to standardise and update on bushing condition.	[REDACTED]	

IMPORTANT: - This condition assessment report provides an overview of the condition of power transformer/s (excluding internal transformer inspections) and high level indications of their residual reliable service life. As it is a snapshot in time and subject to the accuracy of the assessment methodology and ongoing in-service operating environment, the comments in this report are valid for 3 years from the date of the site visit stated above.

© Copyright Powerlink Queensland

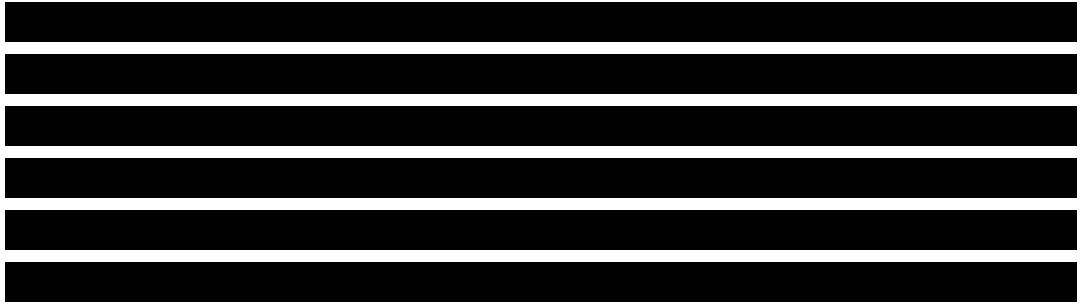
All rights reserved

Powerlink Queensland owns copyright and the confidential information contained in this document. No part of the document may be reproduced or disclosed to any person or organisation without Powerlink Queensland's prior written consent.

Table of Contents

1. SUMMARY 4

[Redacted content]



1. SUMMARY

The H010 Bouldercombe substation transformers T1 and T2 are 38 year old English Electric, Rocklea, Brisbane design and in line with the requirements of AM-POL-0056, a condition assessment has been performed towards “end of life” including an on-site visual assessment combined with a desktop analysis of historical oil and insulation test data, maintenance history and through fault data history where available.

Although power transformer condition is monitored closely, the exact point of power transformer failure cannot be accurately predicted. As the consequences associated with catastrophic power transformer failure in electricity transmission are very high in terms of the financial costs, and potential loss of supply, impact on safety of personnel and public and on the environment (fire, gasses, oil disposal, etc.), the asset management strategy employed is to plan and execute replacement before the actual failure occurs.

This is done by assessing condition of the major transformer components and estimating their end of life as well as that of the overall transformer. As the transformer systems and components deteriorate their probabilities of failure increase leading to an increased risk cost and decreased transformer availability. While component repair or replacement may be possible, in many cases they would provide very little or no benefit with regards to the transformer probability of failure. Typically repairs would have to be performed on a number of power transformer components, whilst the major internal components (insulation, core and mechanical enforcement of internal components) cannot be repaired.

As such, no attempt has been made in this report to cover any detailed economic analysis of the viability of rectifying any highlighted issues associated with these transformers. The report provides a condition assessment of the “key” parameters for these transformers and what may need to be actioned if the transformers are to be operational for a further 5 years and beyond.

A summary of the findings is shown in Table 1. Note that the assessment has revealed that Transformer T1 is in marginally better condition than T2 only in terms of the cellulose insulation system residual life.

Transformers T1 and T2 have an assessed “as-is” residual life expectancy of a 2 to 3 years due to the condition of the cooler bank radiator panels. If there is a need to keep both transformers for 10 years with reduced reliability, then the following actions would still need to be considered.

- Replace cooler bank, including cooling fans. Existing main oil pipework and pumps could be reused. (estimate \$500,000 plus contractor charges for installing).
- Repair the more serious oil leaks on the main tank. (estimate \$150,000 for Contractor).
- New set of bushings (estimate \$200,000 plus Contractor charges for installing).

TABLE 1

Summary of Estimated Residual Life of Transformer T1 & T2 “Key” Components

Parameter	Estimated Residual Life		Further Comments
	T1	T2	
Anti-corrosion system	10 years for main tank. 2 to 3 years for cooler bank	10 years for main tank. 2 to 3 years for cooler bank	Recently repainted. Main tank overall in good condition. Cooler bank will present an increasing maintenance issue. (cooler bank may need to be replaced in near future)
Winding paper life	>10 years	10 years	Calculated Av age = 19 / 21 years for T1 & T2 respectively. Wdg Hot spot age = 24 / 27 years for T1 & T2 respectively.
Winding mechanical stability	Cannot be assessed accurately, but is considered questionable due to design used and exposure.	Cannot be assessed accurately, but is considered questionable due to design used and exposure.	Old clamping structures design, lowering of DPv & moisture exchange.
External HV & LV bushings	Need replacement ASAP	Need replacement ASAP	Refer to clause 2.2.7.4 for rational.
Insulating Oil	5+ years	5+ years	Assuming no big changes to in-service operating conditions.
Radiators	2 to 3 years for cooler bank	2 to 3 years for cooler bank	Oval tube / bottom header interface corrosion issues. Some cooling fans may also need to be replaced.
Repairs to leaking gaskets.	Required now.	Required now.	Many gasket leaks mean air ingress and therefore moisture exchange between air, oil and paper insulation.
Overall residual life.	<5 years. The unreliable service can be extended to 10 years if cooler bank	<5 years. The unreliable service can be extended to 10 years if cooler bank	Assuming on-going maintenance as usual.

Planning Statement – Bouldercombe Transformer Assessment

Recommendation: It is recommended that transformers 1T and 2T be replaced with a single transformer at end of life.

Purpose: The purpose of this paper is to determine the transformation capacity forecast for the Bouldercombe substation.

Background: Bouldercombe substation was established in the 1970’s to reinforce the supply to the growing area of Rockhampton, previously supplied at 132kV from the Callide A substation. At establishment, 2 x 200MVA 275/132kV transformers were installed at Bouldercombe (1T and 2T), and in 2012 a new 375MVA 275/132kV transformer was added to increase the substation capacity. The ratings of the transformers installed at the substation are shown in Table 1 below.

Table 1: Transformer Ratings

Transformer Ratings (MVA)	1T	2T	3T
Normal Cyclic	206	206	466
Emergency Cyclic	224	224	487
2h Short Term	228	228	487

Bouldercombe substation supplies the following substations:

- T023 Rockhampton 132/66kV (Ergon)
- T127 Egans Hill 132/66kV (Ergon)
- T061 Pandoin 132/66kV (Ergon)
- T100 Rocklands 132kV (Aurizon)
- H029 Stanwell PS 132kV (Stanwell Corporation)
- T099 Grantleigh 132kV (Aurizon, via H029)
- T211 Wycarbah 132kV (Aurizon, via H029)

The historic and forecast loadings for H010 Bouldercombe 132kV bus is shown in Figure 1.

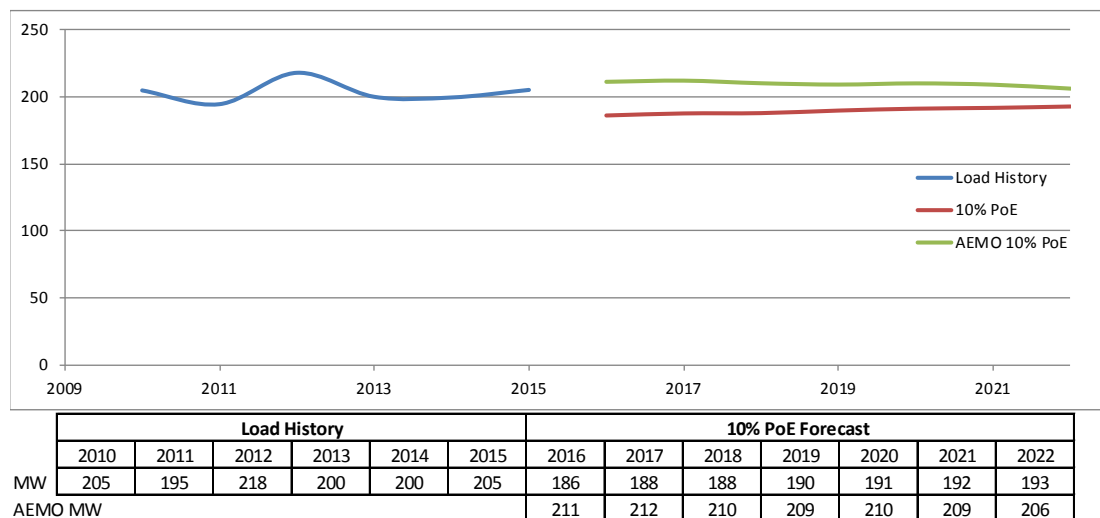


Figure 1: Historic and Forecast loads for H010 Bouldercombe

Latest condition information indicates that 1T and 2T are approaching their end of life, and it is expected that they will be removed from service within the next 10 years.

The following options were considered to address the EOL of transformers 1T and 2T at Bouldercombe.

Option: Remove T1 and T2 from service

Under this option the 2 x 200MVA transformers would be removed from service and their capacity not replaced.

This option would not meet Powerlink's obligations under its Transmission Authority, as more than 50MW of load would be at risk for the loss of the single remaining transformer (the minimum load at Bouldercombe in 2014 was 60MW, and it would take less than 7 hours to breach the 600MWh cap).

There is no interconnecting 132kV network between Bouldercombe and other 132kV injection points, and only minimal 66kV transfers available (to Biloela).

Recommendation: This option should not be considered further on the basis that it does not meet reliability obligations.

Option: Replace T1 and T2 with two transformers

Under this option the 2 x 200MVA transformers would be replaced with 2 new (minimum 200MVA) 275/132kV transformers.

This option would provide adequate N-1 capacity, however in the context of the licence obligations, replacing like for like would provide in excess of the required capacity for the site.

Recommendation: This option should not be considered further on the basis that it does not represent prudent investment.

Option: Replace T1 and T2 with one transformer

Under this option it would be proposed to replace the 2 x 200MVA transformers with a single (minimum 225MVA rated) transformer.

This option provides adequate N-1 capacity and ensures that Powerlink's reliability obligations under its Transmission Authority are met.

Additional considerations in this option is the reduction in scope for the replacement of 275kV and 132kV primary plant, and consideration should be given to coordinating the replacement of the transformers to avoid rework in these projects where it is economic to do so.

Recommendation: This option is recommended on the basis that it meets reliability obligations and represents the most economic and efficient investment decision.