Investment Evaluation Summary (IES)

Project Details:

Project Name:	Port Latta supply transformers - replacement
Project ID:	01680
Business Segment:	Transmission
Thread:	Transmission Substations
CAPEX/OPEX:	CAPEX
Service Classification:	Prescribed
Scope Type:	A
Work Category Code:	RENSB
Work Category Description:	Substations
Preferred Option Description:	Replace existing Port Latta supply transformers (PL-T1 and PL-T2) in the 2019-24 regulatory period.
Preferred Option Estimate (Dollars $2016/2017):	$3,656,032

	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Unit ($)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Volume	0.06	0.65	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Estimate ($)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total ($)	$219,362	$2,376,420	$1,060,249	$0	$0	$0	$0	$0	$0	$0

Governance:

Works Initiator:	Michael Verrier	Date:	03/11/2018
Team Leader Endorsed:	Darryl Munro	Date:	06/11/2018
Leader Endorsed:	Nicole Eastoe	Date:	20/11/2018
General Manager Approved:	Wayne Tucker	Date:	22/11/2018

Related Documents:

Description	URL
Power Transformers AMP	http://reclink/R0000032667
NPV analysis	http://reclink/R0001198231#NPV_V3_Port_Latta_TXs.xlsm
Port Latta T1 and T2 Condition Assessment report	http://reclink /R0000802180#Port_Latta_T1_and_T2_Supply_Transformers_Condition_Assessment_Report.docx
Estimate L1 for new transformers	http://reclink/R0000681118
National Electricity Rules (NER)	http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/Current-Rules
TasNetworks Business Plan 2017-18	http://reclink/R0000779008
TasNetworks Risk Management Framework	http://Reclink/R0000238142
TasNetworks Transformation Roadmap 2025	http://Reclink/R0000764285
TasNetworks Corporate Plan - Planning period: 2017-18	http://reclink/R0000745475
Power Transformer movement details	http://reclink/R0000279578

Section 1 (Gated Investment Step 1)

1. Overview

1.1 Background

Port Latta Substation supply transformers PL-T1 and PL-T2 are critical to ensuring a secure and reliable electricity supply to customers connected to the 110 kV transmission system at Port Latta Substation. These transformers are rated 22.5 MVA, 110/22 kV, manufactured in 1967 and has been installed in their present locations since 1967.

1.2 Investment Need

Port Latta and surrounding area loads are dependant on a secure supply.

Renewal drivers

1.2.1 Design

Supply transformers PL-T1 and PL-T2 at Port Latta Substation are 22.5 MVA units manufactured by AEI in 1967.

In 1994, PL-T2 was taken out of service and taken for factory refurbishment. After the completion of refurbishment the unit was fully tested in the factory environment. A separate oil expansion system for the tap changer on PL-T2 was also added in 1998.

PL-T1 was refurbished in 2000 on-site and the works included 110 kV bushings replacement, addition of a separate oil expansion system for the tap changer and the unit was fully repainted.

On both units, the explosion vents were replaced with pressure relief devices, the radiators were replaced and extra fans were added to achieve a higher ONAF rating.

The units are 51 years old and have reached the end of their economic lives based on Sinclair Knight Mertz "*Assessment of Proposed Regulatory Asset Lives* " report prepared in August 2013 (R192773), which specifies that the economic life of a transformer is 45 years.

TasNetworks Power Transforner AMP aligns to this Sinclair Knight Mertz report and specifies that the economic life of a transformer is 45 years and service life up to 60 years. Replacement of Port Latta supply transformers PL-T1 and PL-T2 aligns with TasNetworks expected average techncial service life of 60 years.

The condition assessment report for these tranformers report has highlighted that PL-T1 and PL-T2 have inherent design deficiencies, predominately that they are subject to cross contamination of the transformer main tank and tap changer, resulting in key dissolved gas analysis results being masked

These transformers have a number of design issues which impact on their expected lifespan and usability in the transmission system.

1.2.2 Condition

The condition assessment was based on key asset management considerations, including technical, design, reliability, condition, maintenance history and requirements, safety and environment issues.

Further asset management evaluation detailed in the condition assessment report states that the electrical and physical condition of the transformer is such that a major refurbishment would not extend the lives of either transformer.

1.2.3 Condition based risk management (CBRM)

A CBRM assessment has been undertaken with resulting health indice indicating an estimated end of life being reached in about 5 years for both PL-T1 and PL-T2.

1.2.4 Defects records

With reference to TasNetworks defects register, there have been 41 defects recorded for PL-T1 and PL-T2 between 1998 and 2017. The majority of defects have been related to tap changer issues, oil leaks and replacement/repair of aging ancillary equipment.

1.2.5 Alignment to asset management plan

The Power Transformer Asset Management Plan (AMP) highlights that to maintain or improve present levels of risk and fault performance in the fleet is for a targeted intervention replacement regime to be utilised. This regime also aligns with an ongoing replacement of approximately 1.6 per cent of the asset population per annum. Replacement of the PL-T1 and PL-T2 aligns with this philosophy. Timing of the project has been optimised for delivery in alignment with the CBRM assessment.

1.3 Customer Needs or Impact

TasNetworks continues to undertake consumer engagement as part of business as usual and through the voice of the customer program. This engagement seeks in depth feedback on specific issues relating to:

- How it prices impact on its services;
- Current and future consumer energy use;
- Outage experiences (frequency and duration) and expectations;
- Communication expectations;
- STPIS expectations (reliability standards and incentive payments); and
- Increasing understanding of the electricity industry and TasNetworks.

Consumers have identified safety, restoration of faults/emergencies and supply reliability as the highest performing services offered by TasNetworks.

Consumers also identified that into the future they believe that affordability, green, communicative, innovative, efficient and reliable services must be provided by TasNetworks.

This project specifically addresses the requirements of consumers in the area of supply reliability.

1.4 Regulatory Considerations

This project is required to achieve the following capital expenditure objectives in alignment with NER 6A.6.7 (Transmission) as outlined in table 1.

Table 1 Capital expenditure objectives relevant to this project.

This project is required to achieve the following capital expenditure objectives:	Yes/No
• Meet or manage the expected demand for prescribed services	Yes
• Comply with all applicable regulatory obligations associated with the provision of prescribed services	Yes

• Maintain the quality, reliability and security of supply of prescribed services	Yes
• Maintain the reliability and security of the system through the supply of prescribed services	Yes
• Maintain the safety of the system through the supply of prescribed services	Yes

2. Project Objectives

The objective of this proposal is to replace the exisiting Port Latta supply transformers (PL-T1 and PL-T2) to:

- Contribute to the achievement of the capital expenditure objectives identified in the NER;
- Provide a safe, secure and reliable electricity supply to customers connected to Port Latta Substation by replacing obsolete, unreliable assets that are in poor condition;
- Achieve life-cycle cost savings due to reduced operations and maintenance requirements; and
- Align with strategic asset management plans with timing of replacement optimised to coincide with remaining life of assets based on CBRM condition assessment.

3. Strategic Alignment

3.1 Business Objectives

Strategic and operational performance objectives relevant to this project are derived from TasNetworks 2017-18 Corporate Plan, approved by the Board in 2017.

This project is relevant to the following areas of the corporate plan:

- We understand our customers by making them central to all we do;
- We enable our people to deliver value; and
- We manage our assets to deliver safe and reliable services while transforming our business.

3.2 Business Initiatives

The business initiatives reflected in TasNetworks Transformation Roadmap 2025 publication (June 2017) for transition to the future that have synergy with this project are as follows:

- Network and operations productivity: We'll improve how we deliver the field works program, continue to seek cost savings and use productivity targets to drive our business.
- Electricity and telecoms network capability: To meet your energy needs and ensure power system security, we'll invest in the network to make sure it stays in good condition, even while the system grows more complex.
- Predictable and sustainable pricing: To deliver the lowest sustainable prices, we'll transition our pricing to better reflect the way you produce and use electricity.
- Enabling and harnessing new technologies and services: By investing in technology and customer service, we'll be better able to host the technologies you're embracing.

4. Current Risk Evaluation

The qualitative risk evaluation summarised in section 4.1 below shows the untreated risk associated with a do nothing option. It equates to a worst case scenario of inherent risk associated with a particular asset. A lower level of likelihood and / or consequence may be applied as part of the sensitivity analysis when calculating the total risk cost as part of the quantitative options analysis.

4.1 5x5 Risk Matrix

TasNetworks' business risks are analysed utilising the 5x5 corporate risk matrix, as outlined in TasNetworks Risk Management Framework.

Relevant strategic business risk factors that apply are as follows:

Risk Category	Risk	Likelihood	Consequence	Risk Rating
Customer	Material supply interuption to customers including major industrial. Failure in service will result in loss of supply to major industrial customer.	Unlikely	Moderate	Medium
Environment and Community	Environmental remediation work. No impact beyond Tasnetworks area.	Unlikely	Minor	Low
Financial	Moderate financial impact. Asset has been identified as exceeded expected life and if fails in service will result in un-intended costs to the business in excess of what would be expected for a controlled CAPEX spend	Unlikely	Moderate	Medium
Network Performance	Localised supply interuption. Asset has been identified as exceeded expected life and if fails in service will result in station not being firm for an extended period until system spare installed. This will also introduce increase pressure on other substations to meet customer supply requirements.	Unlikely	Minor	Low
Regulatory Compliance	No potential to damage relationship with regulator and any breach managed internally.	Unlikely	Minor	Low
Reputation	Some local media attention.	Unlikely	Minor	Low
Safety and People	Risk of injury dependant on asset failure mode and potential industrial action for not adequately maintaining asset. Existing aged assets exhibiting external signs of degradation which	Rare	Severe	Medium

	introduces risk of failure.			

5. Preferred Option:

The preferred option is to replace the existing aged and poor condition supply transformers PL-T1 and PL-T2 at Port Latta Substation.

It is noted that the specifications for a standard type 1 supply transformer has a slighly higher rating that the exisiting transformesr but benefits are that it is a more standardised design, simpler procurement process and will fit with effective spares management. This results in an overall minimal if any cost diference and potential cheaper for a rating like for like replacement.

5.1 Scope

Replace exisiting Port Latta supply transformers (PL-T1 and PL-T2) due to asset condition. Replace with standard type 1 units (25 MVA).

5.2 Expected outcomes and benefits

The outcomes and benefits that are expected to be delivered include:

1. Security of supply maintained for the Port Latta and surrounding areas;
2. Adherance to regulatory considerations; and
3. Identified key business risks are addressed.

5.3 Regulatory Test

Not Applicable.

6. Options Analysis

Completion of options analysis has been undertaken using a modified Net Present Value (NPV) tool, to include Risk Cost. Risk Cost represents the expected annual cost of risk events ($ million) associated with the failure of asset. The business as usual case (BAU) base case definition applied in the options analysis is aligned to Australian Energy Regulator (AER) repex planning guideline. The NPV outcomes for all options considered, is relative to the BAU base case. The NPV tool has also been modified to include a Basis of Preparation. This enables increased transparency of the methodology and analysis undertaken, outlining methodology, key inputs, key assumptions. The Risk Cost methodology is represented as below:

Annual asset risk cost = Probability of Asset Failure (PoF) * Asset units (No) * Likelihood of Consequence of Failure (LoC) * Cost of Consequence (CoC).

The analysis of all options is aligned with the Australian Energy Regulators application note for asset replacement planning, to ensure alignment of our approach. The risk cost categories, likelihood and consequence ratings are aligned with TasNetworks Corporate Risk Framework. The categories can also be mapped to the AER's repex planning guideline

AON, TasNetworks corporate insurer provided Cost of Consequence (CoC) and Likelihood of Consequence (LoC) data. We have also analysed our assets and sought additional benchmarked data to develop Likelihood of Failure, Likelihood of Consequence and Cost of Consequence when it can be obtained.

The replacement of Port Latta Substation transformers PL-T1 and PL-T2 with new standard type 1 units (25 MVA) in

revenue reset period 2019-2024, option 1, is the preferred option. This is the most approriate solution to address the project requirements. Replacing with new Supply Transformers is the preferred outcome to provide for best whole of life and supply reliability and security requirements and is the most positive NPV economically.

6.1 Option Summary

Option description	
Option 0	Do nothing and replace on failure.
Option 1 (preferred)	Replace existing Port Latta supply transformers (PL-T1 and PL-T2) in the 2019-24 regulatory period.
Option 2	Defer replacement of existing Port Latta supply transformers (PL-T1 and PL-T2) until the following 2025-29 regulatory period.
Option 3	Staggered replacement of existing Port Latta supply transformers PL-T1 in the 2019-24 regulatory period and PL-T2 in the 2024-29 regulatory period.

6.2 Summary of Drivers

Option	
Option 0	Do nothing and replace on failure Retain exisiting transformers and review need to increase the maintenance practice frequency. Scope The proposed scope for this option includes: • Maintaining transformers PL-T1 and PL-T2 and run to failure. Benefits The benefits for this option are: • No capital expenditure. Drawbacks The drawbacks for this option are: • Higher operational costs; • Adverse impact on transformer availability due to extended and more frequent outage requirements; • Increased likelihood of transformer failure; and • Reactive replacement.
Option 1 (preferred)	Replace transformers with new units in revenue reset 2019-2024 This option includes the replacement of the existing PL-T1 and PL-T2 with new standard type 1 25 MVA transformers of a standardised design . This option addresses all the condition issues associated with this transformer.

	Scope The proposed scope for this option includes: • Replacement of transformers PL-T1 and PL-T2 in 2019-2024 revenue reset period Benefits The benefits for this option are: • Most positive economical outcome from NPV analysis including monetised risk; • Replacement of transformer in declining condition; • Mitigates against a failure of PL-T1 or PL-T2; • Reduction in maintenance costs; and • Planned replacement. Drawbacks The drawbacks for this option are: • High capital cost.
Option 2	Replace transformers with new units in revenue reset 2024-2029 This option includes the replacement of the existing PL-T1 and PL-T2 with new standard type 1 25 MVA transformers of a standardised design . This option addresses all the condition issues associated with this transformer. Scope The proposed scope for this option includes: • Replacement of transformers PL-T1 and PL-T2 in 2024-2029 revenue reset period. Benefits The benefits for this option are: • Deferred capital expenditure on replacement of transformer in declining condition. Drawbacks The drawbacks for this option are: • High capital cost; • Increased maintenance costs; and • Continue with higher risk of failure as opposed to if new transformer.
Option 3	Staggered replacement of transformers with new units in revenue resets 2019-2024 and 2024-2029 This option includes the replacement of the existing PL-T1 and PL-T2 with new standard type 1 25 MVA transformers of a standardised design . This option addresses all the condition issues associated with this transformer. Scope

	The proposed scope for this option includes: • Replacement of transformer PL-T1 in 2019-2024 revenue reset period • Replacement of transformer PL-T2 in 2024-2029 revenue reset period Benefits The benefits for this option are: • Deferred some capital expenditure on replacement of transformer in declining condition. Drawbacks The drawbacks for this option are: • Higher capital cost; • Inefficient use of project resources; • Increased maintenance cost for remaininin unit; and • Continue with higher risk of failure as opposed to replacing both transformers in 2019-2024 period.

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0
Option 1 (preferred)	$3,656,032
Option 2	$3,656,032
Option 3	$4,307,159

6.4 Summary of Risk

Option 0: Do Nothing and replace on failure.

Identified risks predominately to customers, financial, network performance, regulatory compliance, reputation and safety increase further over time as the asset condition deteriorates further.

Option 1: Replace existing Port Latta supply transformers (PL-T1 and PL-T2) in the 2019-24 regulatory period.

Reliability of supply maintained for the long term. Risks to customers, financial and safety reduced substantially.

Option 2: Defer replacement of existing Port Latta supply transformers (PL-T1 and PL-T2) until the following 2025-29 regulatory period

The deferment of the replacement would result in an increased exposure to a failure.

With the asset failure likelihood increasing due to condition degradation, the risks to customers, financial and safety continue as per do nothing option for greater period of time.

Option 3: Staggered replacement of transformers with new units in revenue resets 2019-2024 and 2024-2029

The deferment of the replacement of one transformer would result in an increased exposure to a failure.

With the asset failure likelihood increasing due to condition degradation, the risks to customers, financial and safety continue as per do nothing option for greater period of time.

6.5 Economic analysis

Option	Description	NPV
Option 0	Do nothing and replace on failure.	-$11,328,078
Option 1 (preferred)	Replace existing Port Latta supply transformers (PL-T1 and PL-T2) in the 2019-24 regulatory period.	$5,620,720
Option 2	Defer replacement of existing Port Latta supply transformers (PL-T1 and PL-T2) until the following 2025-29 regulatory period.	$1,370,339
Option 3	Staggered replacement of existing Port Latta supply transformers PL-T1 in the 2019-24 regulatory period and PL-T2 in the 2024-29 regulatory period.	$686,517

6.5.1 Quantitative Risk Analysis

A quantitative risk analysis has been completed including the cost of risk as described in section 6 above. The most positive option has been selected as the preferred option.

Also a quantitative risk analysis was completed using TasNetworks CBRM tool. The CBRM tool was used to identify the highest risk and prioriity power transformers in TasNetworks fleet. The results highlighted the expected end of life period and associated risk to the network. PL-T1 and PL-T2 were identifed as two of several transformers approaching end of life.

6.5.2 Benchmarking

TasNetworks participates in various formal benchmarking forums with the aim to benchmark asset management practices against international and national transmission companies. Key benchmarking forums include:

- International Transmission Operations & Maintenance Study (ITOMS); and
- Transmission survey, which provides information to the Electricity Supply Association of Australia (ESAA) for its annual Electricity Gas Australia report.

In addition, TasNetworks works closely with transmission companies in other key industry forums, such as CIGRE (International Council on Large Electric Systems), to compare asset management practices and performance.

ITOMS provides a means to benchmark asset class averages (maintenance cost & service levels) between related utilities from around the world. There is a strong need to ensure capital expenditure, maintenance processes and procedures are continually reviewed to ensure optimum financial and service benefits and minimal fault outages.

The completion of this project is expected to ensure TasNetworks continues to meet it benchmarking obligations and any improvement initiatives related to those benchmarking results.

6.5.3 Expert findings

Not Applicable.

6.5.4 Assumptions

Project work assumption includes that along with new transformers some work may be required on exisiting bund and oil containment, Transformer bay switchgear and conductors and protection

Unserved energy and/or network penalties used in NPV:

1. Use average energy through line or transformer;
2. Apply failure rate, typically for transmission transformer assets assume to be 0.5 per cent for aged and one tenth of this or 0.05 per cent for new.