Investment Evaluation Summary (IES)

Project Details:

Project Name:	GT-TE 110kV Transmission Line Replacement
Project ID:	01428
Business Segment:	Transmission
Thread:	Transmission Lines
CAPEX/OPEX:	CAPEX
Service Classification:	Prescribed
Scope Type:	A
Work Category Code:	RENTL
Work Category Description:	Transmission Lines
Preferred Option Description:	Renew Transmission Line
Preferred Option Estimate (Dollars $2016/2017):	$3,999,184

	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Unit ($)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Volume	0.00	0.00	0.36	0.64	0.00	0.00	0.00	0.00	0.00	0.00
Estimate ($)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total ($)	$0	$0	$1,439,706	$2,559,478	$0	$0	$0	$0	$0	$0

Governance:

Works Initiator:	Andrew Ling	Date:	09/11/2018
Team Leader Endorsed:	Darryl Munro	Date:	15/11/2018
Leader Endorsed:	Nicole Eastoe	Date:	20/11/2018
General Manager Approved:	Wayne Tucker	Date:	22/11/2018

Related Documents:

Description	URL
Asset Management Plan	http://Reclink/R32681
TasNetworks Business Plan 2017-18	http://Reclink/R779008
TasNetworks Risk Management Framework	http://Reclink/R238142
National Electricity Rules (NER)	http://www.aemc.gov.au/Energy-Rules/National-electricityrules/
Estimate	http://Reclink/R681173
NPV	http://Reclink/R1190837
Condition Assessment Report	http://Reclink/R740573
TasNetworks Transformation Roadmap 2025	http://Reclink/R764285
TasNetworks Corporate Plan - Planning period: 2017-18	http://Reclink/R745475

Section 1 (Gated Investment Step 1)

1. Overview

1.1 Background

The GT-TE 110kV transmission line was initially constructed in 1962 (55 years old) to supply a manganese processing plant, via a neighbouring aluminium smelter. Since then the line has been re-routed to bypass the smelter. The line was expected to have a life span of 60 years and is 3100m long, consisting of galvanised steel support towers. The current line is strung with both GOAT and IBIS Aluminium Conductor Steel Reinforced (ACSR) conductor along with some 19/.116 Cu which is rated at 60 °C under normal operating conditions.

As the line is relatively short (3110m) and located within a primarily industrial area, very few faults and reliability issues have occurred over its 55 years of service. Continual planned inspections and maintenance programs (including previous tower painting in lead based paint) have ensured the line has remained serviceable for this time. However, as it's located in close proximity to the coast and is reaching the end of its expected working life, recent inspections have highlighted numerous corrosion issues on the support towers that will need to be addressed in order to ensure the line remains safe and functional.

1.2 Investment Need

Recent condition assessment after aerial inspection in late 2016 has identified 54 Priority 3 defects, all of which are caused by corrosion to the towers structural members, bolts, insulator strain assemblies, step bolts and anti-climbing devices. These issues apply to all of the support towers and if corrective measures are not carried out to address these issues, ongoing reliability of the line cannot be ensured.

1.3 Customer Needs or Impact

The GT-TE 110kV transmission line is a double circuit radial line solely supplying a major industrial customer. Due to the nature of the industrial load at the customer site, reliable supply is critical and any loss of supply could have a potential significant impact on their operations.

Negotiations with customer regarding the future of the existing transmission line are currently underway with replacing the line viewed favourably. Replacing the line will have no impact on pricing to the customer with the existing line grandfathered as shared network asset.

1.4 Regulatory Considerations

This project is required to achieve the following capital expenditure objectives as described by the National Electricity Rules section 6A.6.7.

This project is required to achieve the following capital expenditure objectives:	Yes/No
Meet or manage the expected demand for prescribed services.	No
Comply with all applicable regulatory obligations associated with the provision of prescribed services.	No
Maintain the quality, reliability and security of supply of prescribed services.	Yes - failure of the transmission line will adversely affect the quality, reliability and security of

	supply
Maintain the reliability and security of the system through the supply of prescribed services.	Yes - failure of the transmission line will affect the reliability and security of supply
Maintain the safety of the system through the supply of prescribed services	Yes - failure of the transmission line will affect the safety of the system.

2. Project Objectives

This project proposes to replace the transmission line to mitigate the risk of transmission line failure which could result in:

- potential safety incidents;
- decreased circuit reliability; and
- increased lifecycle costs of the transmission line.

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 care for our assets, delivering safe and reliable networks 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:

- Voice of the customer: We anticipate and respond to your changing needs and market conditions.
- 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.

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	Degraded transmission line results in failure to foundation, structure, or conductor assembly leading to major disruption to a major industrial customer.	Rare	Moderate	Low
Environment and Community	Degraded transmission line results in failure to foundation, structure, or conductor assembly leading to fire.	Almost Certain	Minor	Medium
Financial	Degraded transmission line results in failure to foundation, structure, or conductor assembly leading to loss of revenue and fines.	Almost Certain	Minor	Medium
Network Performance	Degraded transmission line results in failure to foundation, structure, or conductor assembly leading to a network event.	Rare	Minor	Low
Regulatory Compliance	Degraded transmission line results in failure to foundation, structure, or conductor assembly leading to a network event and inability to supply load on the radial transmission line.	Rare	Moderate	Low
Reputation	Degraded transmission line results in failure to foundation, structure, or conductor assembly leading to negative media coverage.	Almost Certain	Negligible	Medium
Safety and People	Degraded transmission line results in failure to foundation, structure, or conductor assembly leading to serious injury or loss of life.	Rare	Severe	Medium

5. Preferred Option:

Option 1 is the preferred option as it satisfies the objectives outlined in this Investment Evaluation Summary (IES). The preferred option will consist of the replacing the transmission line with the construction of a new double circuit 110 kV transmission line to TasNetworks current standard designs. This standard design uses double circuit steel pole support structures with conductor strung at 75 °C.

Option 1 addresses the requirement to mitigate the risk of transmission line support structure, insulator assembly or conductor assembly failure and an unacceptable increase in risk to the loss of a major industrial customer and damage to TasNetworks' reputation. Option 1 to renew the line at end of life is typical of best industry practice.

The NPV of Option 1 relative to Option 0 is $54 million, and the NPV demonstrates that Option 1 is preferred over Option 2. The high NPV is representative of the risk exposure to a significant outage through the failure of a support structure across the different options.

The benefit of implementing this option is that TasNetworks can maintain the transmission line to meet service level agreements, comply with appropriate Australian standards, maintain its current acceptable level of risk exposure and meet performance targets.

5.1 Scope

Replace the existing double circuit 110 kV transmssion line to TasNetworks standard steel pole double circuit arrangement with standard 110 kV conductor.

5.2 Expected outcomes and benefits

Replacing the transmission line will maintain or reduce the current risk of asset failure, decrease the risk to public safety and the environment while maintaining the current level of service to the transmission customer connected to the end of the line.

This expected benefits of this project are outlined as follows:

- mitigation of potential safety incidents;
- increased circuit reliability; and
- decreased lifecycle costs of the transmission line.

5.3 Regulatory Test

The asset replacements within this project do not require a Regulatory Investment Test for Transmission (RIT-T) as per the requirements of the NER.

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 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 summary of costs outlined in section 6.3 below indicates the planned capital expenditure for repex over the 2019-24 period.

6.1 Option Summary

Option description	
Option 0	Do nothing (no capital expenditure)
Option 1 (preferred)	Renew Transmission Line
Option 2	Refurbish Existing Transmission Line
Option 3	Defer Renewal of Transmission Line

6.2 Summary of Drivers

Option	
Option 0	Option 0 involves no preventative replacement works. Corrective and emergency replacement will only be carried out when required. This option does not address the safety risks presented by a mechanical failure of a tower or an insulator string and the subsequent dropping of the conductor, nor does it mitigate the risk to the loss of a major industrial or TasNetworks' reputation. This option is not aligned with the objectives and risk mitigation

	requirements identified in this IES. This option does have the benefit of capital expenditure deferral but is not aligned with the strategies in TasNetworks' Asset Management Plan, instituted to allow TasNetworks to maintain transmission system performance in a prudent and efficient manner.
Option 1 (preferred)	Option 1 is to completely replace the 110kV transmission line due to the large number of components approaching end of life and requiring major refurbishment to extend their life. This option involves the construction of a new double circuit 110kV transmission line to TasNetworks current standard designs. This standard design uses double circuit steel pole support structures with conductor strung at 75 °C. This design will ensure that the current customer load can be supplied with no operational constraints. By replacing the transmission line this option fully addresses TasNetworks' business, safety, and reputational risks identified in this IES. Option 1 is aligned with the Asset Management Plan, strategic plan, and strategic performance objectives set by the business.
Option 2	Option 2 is to refurbish the existing double circuit 110kV transmission line components to extend its service life. This is achieved by programmed tower painting, insulator and conductor replacement, and foundation works. Tower painting and insulator replacement would be conducted in 2019/20 with conductor replacement and foundation works to be done in 2022/23. Repainting has an expected life of 15 years, hence repainting will be required periodically in the future. Refurbishment of the line presents an increased operational and safety risk to the business during maintenance works due to the requirement to maintain supply while containing lead contaminates in the existing paint during tower painting and the need to take a circuit out of service for insulator and conductor replacements. By refurbishing the 110kV transmission line this option fully addresses TasNetworks' business, safety, and reputational risks identified in this IES. Option 2 is also aligned with the Asset Management Plan, strategic plan, and strategic performance objectives set by the business.
Option 3	Option 3 is to conduct sufficient maintenance activities on the existing transmission line assets and defer the complete replacement of the 110kV transmission line until the 2024-29 regulatory period. This option involves limited foundation, bolt and tower member replacements in the 2019-24 regulatory period to ensure the reliable operation of the transmission line until renewal in 2024-29. By replacing the transmission line this option fully addresses TasNetworks' business, safety, and reputational risks identified in this IES. Option 3 is aligned with the Asset Management Plan, strategic plan, and strategic performance objectives set by the business.

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0
Option 1 (preferred)	$3,999,184
Option 2	$5,325,000
Option 3	$4,377,185

6.4 Summary of Risk

With a potentially severe safety consequence as a result of a transmission line failure the risk rating can not be reduced below medium.

To maintain a medium risk rating the transmission line will require either replacement or refushishment otherwise the risk rating will increase through an increase in the likelihood of failure.

Option No.	Option description	NPV	Reason for selection/rejection
0	Do nothing (no capital expenditure)	-$5,009,180	Rejected – This option is rejected as it exposes TasNetworks to unacceptably high levels of risk, specifically risks relating to safety and circuit reliability.
1	Replace Transmission Line	$2,683,489	Preferred – Option mitigates the risk of transmission line end of life failure, improves circuit reliability, reduces the lifecycle costs of the transmission line, and is the most favourable option economically.
2	Refurbish Transmission Line	$1,045,721	Rejected – This option is rejected as it has higher risks to safety and security of supply during refurbishment works and a higher economic cost in comparison to Option 1.
3	Defer Renewal of Transmission Line	$2,552,291	Rejected – This option is rejected as it has higher a higher economic cost in comparison to Option 1.

6.5 Economic analysis

Option	Description	NPV
Option 0	Do nothing (no capital expenditure)	-$5,009,180
Option 1 (preferred)	Renew Transmission Line	$2,683,489
Option 2	Refurbish Existing Transmission Line	$1,045,721
Option 3	Defer Renewal of Transmission Line	$2,552,291

6.5.1 Quantitative Risk Analysis

A Quantitative Risk Analysis has been completed for this investment.

For the NPV the failure rate is assumed to be the failure rate for a single transmission line support structure in the transmission line.

The initial condition is set at a 1 in 100 year failure (original design criteria for the line for the relevant standard of the time) and is exponentially extrapolated to one structural failure in 25 years if no preventative maintenance is performed due to the asset being considered at end of life.

A new transmission line will be designed to Australian Standards is assumed to have a 1 in 200 year failure flat for the NPV assessment period.

A refurbished transmission line is assumed to retain a 1 in 100 year failure rate for 20 years before the following an increasing failure rate due to the asset reaching the end of its life extension end of life.

It is assumed that any transmission line support structure failure will result in a cascading failure with one support structure failure either side of the failed support structure.

As a result of a support structure failure the following is assumed:

Safety risk: 1 in 50 support structure failures will result in an injury which results in less than a week off work.

Property Risk: A support structure failure will result in a major loss of supply and insurance claims especially in the run to failure scenario.

Environment & Community: A support structure failure in the case of Option 0 will result in lead based paint being released into the environment and a resultant environmental clean-up.

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
- Australian Energy Regulator (AER) Regulatory Information Notices (RIN).

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

Replacement of a transmission line with a large number of components near or at end of life is considered industry best practise.

6.5.3 Expert findings

The following condition assessment report was prepared by TasNetworks' Works and Service Delivery Group:

- R740573 Condition Assessment Report, GT-TE 110 kV transmission line.

The condition assessment recommended that works be undertaken to ensure safety and reliability of the transmission line.

6.5.4 Assumptions

The major assumptions used in the NPV are as follows:

- NPV analysis is carried out for a 25 year period (2019 to 2044);
- A discount rate of 3.59 per cent is used;
- Value of Customer Reliability (VCR) of $5,290 per megawatt-hour of electricity for metals based sector (used to calculate the cost of involuntary load shedding);
- Painting of lattice towers lasts for 15 years before repainting is required; and
- The conductor on the exiting line will require replacement due to condition by the end of the 2019-24 reset period.