Investment Evaluation Summary (IES)

Project Details:

Project Name:	Replace Crossarm (Safety)
Project ID:	00698
Business Segment:	Distribution
Thread:	Overhead
CAPEX/OPEX:	CAPEX
Service Classification:	Standard Control
Scope Type:	B
Work Category Code:	RELSA
Work Category Description:	Replace LV Feeders (Substandard)
Preferred Option Description:	Condition based replacement
Preferred Option Estimate (Dollars $2016/2017):	$9,456,000

	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Unit ($)	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
Volume	1540.00	797.00	797.00	797.00	797.00	797.00	797.00	797.00	797.00	797.00
Estimate ($)	$3,080,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000
Total ($)	$3,080,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000	$1,594,000

Governance:

Works Initiator:	David Eccles	Date:	25/10/2017
Team Leader Endorsed:	Darryl Munro	Date:	30/10/2017
Leader Endorsed:	Nicole Eastoe	Date:	24/11/2017
General Manager Approved:	Wayne Tucker	Date:	25/11/2017

Related Documents:

Description	URL
AROCO REHSA RELSA Volumes and Dollars.xlsx	http://teamzone.tnad.tasnetworks.com.au/asset-strategy/Shared%20Documents/DD17/Overhead%20Thread/AROCO%20RELSA%20REHSA%20Overhead%20System%20Asset%20Repair/AROCO%20REHSA%20RELSA%20Volumes%20and%20Dollars.xlsx
RELSA NPV	http://reclink/R732569
TasNetworks Corporate Plan - Planning period: 2017-18	http://reclink/R745475
TasNetworks Transformation Roadmap 2025	https://www.tasnetworks.com.au/customer-engagement/submissions/
Overhead Conductors and Hardware Asset Management Plan	http://reclink/R260427
TasNetworks Risk Management Framework	http://Reclink/R238142

1. Overview

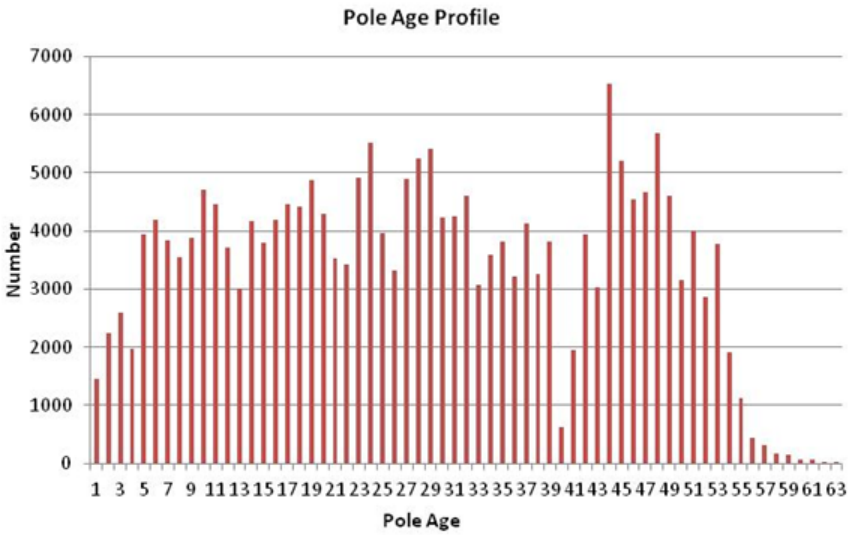
1.1 Background

Crossarms are used to connect the insulators which hold the conductors to the support structures (poles) and provide adequate clearance between the conductors. TasNetworks' Low Voltage (LV) crossarms are predominantly manufactured from sawn timber as this medium is cost effective and offers insulation qualities to allow live line activities to be performed safely. There are around 210,000 wooden LV crosarms in the distribution network. *Figure 1* shows an example of a wooden LV crossarm, they have a relatively short service life of approximately 20 years. This Investment Evaluation Summary (IES) does not cover steel crossarms which are used for the High Voltage (HV) network or fibreglass crossarms which are currently being trialled in the LV network.

Figure 1: Sawn wooden LV crossarms

TasNetworks does not keep detailed records of its pole top hardware (including LV crossarms). However, as pole top hardware is generally installed new whenever a pole is replaced, pole age (as shown in *Figure 2*) serves as a reasonable proxy for poletop hardware age. While most poles have a life of around 45 to 50 years, the oldest poles in the system are over 60 years old.

Figure 2: Pole Age Profile



Age, design, construction methods, fault currents and environmental considerations such as proximity to coastlines and prevailing winds will all impact the service life of the pole top components including crossarms.

Outages on rural feeders generally have a greater impact upon reliability as rural distribution feeders tend to be lengthy (between 50 and 500 km) and of a radial nature with limited ability to interconnect with other adjacent rural distribution feeders. Consequently TasNetworks is vulnerable to

asset failures causing impacts on its ability to provide service to customers.

Defects or failures of wooden LV crossarms on overhead feeders also have a high likelihood of causing bushfires.

This is a continuation of existing a program to proactively rectify wooden LV crossarm defects in the overhead system.

Improved Inspection Practices

In 2014/2015 for the first time TasNetworks started inspecting its assets from the air to supplement the traditional ground based inspection methods. This provided a previously hidden view of the network that showed many wooden LV crossarms were in worse condition than previously thought. In particular there was a spike in decayed timber crossarms reported, as these tend to rot on top while remaining intact on the underside, making it difficult to detect from ground patrols. *Figures 3 and 4* show the same pole from both ground level and from an aerial inspection view point, the advantage of using aerial inspections to better assess the condition of crossarms is apparent.

Figures 3 and 4: The same pole seen from the ground and from the air

Aerial inspections are conducted on a five year cycle. An increase in overhead maintenance is required over the five years (2015/2016 – 2019/2020) to repair defective wooden LV crossarms identified during the first round of aerial inspections, as these will pick up defects that have gone undetected for many years due to the previous ground based inspection methods.

1.2 Investment Need

The drivers for this program are to:

- Reduce risk of fire starts from asset failure of wooden LV crossarms;
- Reduce risk to public safety from asset failure of wooden LV crossarms; and
- Maintain asset reliability for wooden LV crossarms and improve it in areas where reliability is consistently below target thresholds.

Further details of the investment drivers and considerations are provided below.

Fire Start:

Routine maintenance and defect rectification on the overhead system play a critical role in reducing the risk of a fire starting from TasNetworks' assets.

There is no history of powerlines in Tasmania starting catastrophic bushfires, however the experience in mainland Australia is that powerlines can start bushfires. Whilst the average number of bushfires started by powerlines is relatively low (1- 4 per cent of all bushfires) (REF: Powerline Bushfire Safety Taskforce – Final Report 30 September 2011), inquiries into catastrophic bushfires in Victoria have found that a disproportionate number have been started by powerlines.

Tasmania experiences an average of 3 Total Fire Ban (TFB) days a year, although some years, for example 2012/2013 – the year of the 'Dunalley Fires' - there were 11 TFB days.

From Reliability Centred Maintenance (RCM) analysis undertaken in 2012, TasNetworks identified 139 potential failure modes for its overhead assets, 58 of which are considered fire start risks. Assets are inspected from the ground on 5 yearly cycles.

Public Safety:

TasNetworks' distribution assets interface with the public every day. Assets are located outside schools, hospitals, shops, across paddocks and at bus stops. If wooden LV crossarm defects are left unrectified, there's an unsatisfactory risk of a injury or even death to the public, for example through broken hardware falling from a pole top, or electrocution through accidental contact with assets.

Projected Volumes:

The volume of defective wooden LV crossarms identified during the first aerial audit completed on 20 per cent of the network located in the High Bushfire Loss Consequence Area in 2014/15 was used in conjunction with the age profile of all installed wooden LV crossarms to approximate the anticipated volume of replacements required under this program for the rest of the state.

The replacement program started in 2015/16 and targetted approximately 1500 replacements per annum for five years to manage the risk associated

with the expected backlog of reported defective wooden LV crossarms with the annual volume determined by TasNetworks' cabability to complete the program. The age profile of installed wooden LV crossarms has been used as a proxy for condition to anticipate replacement volumes following the completion of work identifed during the first round of aerial audits, with the volume of wooden LV crossarm defects identified by subsequent combined aerial and ground inspections anticipated to settle back to 800 replacements per year.

In addition to this, approximately of 1000 wooden LV crossarms are replaced annually in conjunction with other programs such as pole replacements (IES 661 REPOL), bushfire mitigation (IES 1508 SIFIC) and fault and emergency (IES 963 EMRES).

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 its 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)

• 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 areas of:

• safety, restoration of faults/emergencies and supply reliability

• affordability, green, communicative, innovative, efficient and reliable services

Customers will continue to be consulted through routine TasNetworks processes, including the Voice of the customer program, the Annual Planning Review and ongoing regular customer liaison meetings.

1.4 Regulatory Considerations

This project is required to achieve the following capital expenditure objectives as described by the National Electricity Rules section 6.5.7(a).

6.5.7 (a) Forecast capital expenditure:

(2) comply with all applicable *regulatory obligations or requirements* associated with the provision of *standard control services*;

(3) to the extent that there is no applicable *regulatory obligation or requirement* in relation to:

(i) the quality, reliability or security of supply of *standard control services*; or

(ii) the reliability or security of the *distribution system* through the supply of *standard control services*,

to the relevant extent:

(iii) maintain the quality, reliability and security of supply of *standard control services*; and

(iv) maintain the reliability and security of the *distribution system* through the supply of *standard control services*; and

(4) maintain the safety of the *distribution system* through the supply of *standard control services*.

2. Project Objectives

To replace wooden LV crossarms on the overhead system to reduce the risk of fire starts, harm to the public and to maintain network reliability.

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.
- 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

If TasNetworks does not continue to inspect and replace LV wooden crossarmss there is a risk that a crossarm failure could result in death or serious injury to a member of the public or staff, lead to a severe bushfire or cause significant customer outages.

The business risk associated with these assets has been evaluated as High by using the TasNetworks risk management framework.

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	Disruption to customer supply from declining network reliability caused by wooden LV crossarm failures.	Unlikely	Minor	Low
Environment and Community	A wooden LV crossarm failure results in catastrophic bushfire with widespread loss of property, environmental damage and potential fatality.	Unlikely	Severe	High
Financial	Excessive payout of reliability incentive schemes (STPIS, GSL, NECF) from declining network reliability. A wooden LV crossarm failure results in catastrophic bushfire, insurance providers refuse to cover TasNetworks for future events.	Unlikely	Major	Medium
Regulatory Compliance	Increased number of unplanned outages caused by wooden LV crossarm failure, leads to frequent National Energy Customer Framework (NECF) and National Electricity Rules (NER) breaches.	Unlikely	Minor	Low
Reputation	A wooden LV crossarm failure results in catastrophic bushfire or injury with significant media coverage.	Unlikely	Major	Medium
Safety and People	A wooden LV crossarm failure results in injury or death to member of the public or staff.	Unlikely	Severe	High

Section 2 (Gated Investment Step 2)

5. Preferred Option:

The preferred option is to repair or replace assets reported during inspections that are deemed to pose an unacceptable risk.

5.1 Scope

The work to be undertaken shall be repairs to defective wooden LV crossarms. This program aims to focus on wooden LV crossarms that if they were to fail in service, would have consequences (e.g critical assets, fire risks, etc). Tasks under this program are generated by the asset inspection programs (AIOHS Overhead Structures inspection and monitoring and AIOFD OH Feeder Auditing and Inspection and are prioritised for actioning based on the severity of the defect and its location geographically and in the network with regards to the three driving criteria:

- Risk of fire start
  - Targets those wooden LV crossarm defects that if left unrectified may result in fallen conductors and potentially result in a fire.
  - Fire start defects are prioritized in areas where the surrounds increase the likelihood of a fire starting, for example in bushland areas, or dry grassy areas. The High Bushfire Loss Consequence Area is prioritised.
- Risk to safety
  - Targets those wooden LV crossarm defects that if left unrectified may result in death or injury to a person, for example through broken hardware falling from a pole top, or electrocution through accidental contact with assets.
  - Safety risk defects are prioritised in areas subject to human access, e.g urban areas, farms with working equipment, etc.
- Reliability
  - Network robustness – the defects or asset components that contribute the most to failures under fault are targeted for rectification.
  - Asset criticality – LV crossarm faults on critical poles (such as poles with transformers, complicated pole top configurations or difficult to access) may be more expensive to repair under fault and have a bigger impact on outage durations and STPIS penalties than other less critical assets.

5.2 Expected outcomes and benefits

The expected outcome of this program is a reduction in risk to TasNetworks from fire starts and public safety risks, and no increase in the number and duration of unplanned outages.

5.3 Regulatory Test

A Regulatory Investment Test will not be required for this program.

6. Options Analysis

6.1 Option Summary

Option description	
Option 0	Do Nothing
Option 1 (preferred)	Condition based replacement
Option 2	Replace wooden crossarms at 20 years

6.2 Summary of Drivers

Option	
Option 0	Advantages: • Lowest expenditure option. Disadvantages: • Does not reduce the likelihood of injury or fatality due to a failed crossarm; • Does not reduce the likelihood of exposure of the public to energised electrical equipment or being hit by a failed crossarm or dropped conductors; • Drastically increases TasNetworks' likelihood of igniting a severe bushfire from a failed crossarm; and • Customers will be exposed to increased unplanned outages. If crossarms are not replaced after failure, it is likely

	TasNetworks would be unable to service some customers.
Option 1 (preferred)	Advantages: • Expenditure in completing this work is sustainable; and • Minimises likelihood of exposure to the public and bushfire ignition. Disadvantages: • Cannot completely eliminate the risk of in service wooden LV crossarm failures.
Option 2	Advantages: • Will maintain an age base of wooden crossarms 20 years or less. Disadvantages: • Significant expenditure to undertake this option as many crossarms will be replaced pre-maturely prior to end of life; • Does not do enough to reduce the likelihood of a failed crossarm causing injury or fatality. By replacing crossarms purely by age there is still a high risk of poor condition crossarms less than 20 years old failing; and • Environmental factors have shown to have a greater influence on condition compared to age. Therefore age alone is not a good proxy for condition or time till failure.

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0
Option 1 (preferred)	$9,456,000
Option 2	$12,900,000

6.4 Summary of Risk

Option 0 - Do Nothing:

The associated risk of this option is unchanged and remains High in accordance with the TasNetworks risk management framework. This evaluation is driven by:

- The high risk to public and staff safety from crossarm failure;
- Reduced network reliability of customer supply due to increased incidents of unplanned outages due to crossarm failure and subsequant fallen conductors; and
- This option has the lowest upfront expenditure however high additional costs to the business are incurred in the form of regulatory and compliance breaches. As this option does not address the risk to public safety it is highly likely to involve further costs due to incidents and legal proceedings.

Option 1 - Replace Based on Condition (Prefered Option):

By replacing wooden LV crossarms once they are identified as defective, the ongoing risk is considered Low in accordance with the TasNetworks risk management framework. This evaluation is driven by:

- The risks to public safety from crossarm failure are low but cannot be removed entirely;
- The likliness of unplanned outages occuring due to crossarm failures are significantly reduced; and
- This is the lowest expenditure option that still addresses the risk to public safety.

Option 2 - Replace based once 20 years of age:

The associated risk of this option is reduced to Medium in accordance with the TasNetworks risk management framework. This evaluation is driven by:

- The risks to public safety from crossarm failure are lower than Option 0 but still does not adequately address public safety;
- There will be a lower incident of unplanned outages due to crossarm failure compared to Option 0 but a higher number of outages compared to Option 1; and
- This is the highest expenditure option. This option necessitates the premature replacement of some assets. Additional costs to the business in the form of regulatory and compliance breaches are lower than for Option 0 but are likely to be higher than Option 1.

6.5 Economic analysis

Option	Description	NPV
Option 0	Do Nothing	-$9,973,023
Option 1 (preferred)	Condition based replacement	-$19,907,730
Option 2	Replace wooden crossarms at 20 years	-$24,125,020

6.5.1 Quantitative Risk Analysis

Not Applicable.

6.5.2 Benchmarking

This Wooden LV crossarm replacement program is consistent with similar programs implemented by other Australian Distribution Network Service Providers.

Recent ENA industry benchmarking indicates that TasNetworks is below National averages for LV crossarm failures and average for the volume of LV crossarm replacements.

6.5.3 Expert findings

Not Applicable.

6.5.4 Assumptions

Program values have been determined using historical unit replacement costs where available.

It is assumed that the failure rate will decrease in the next revenue reset peroiod due to the use of aerial inspections since 2014/15, which are more effective at identifying wooden LV crossarm defects compared to the previous ground level inspection method.

Related Projects

A separate, similar program exists for wooden LV crossarms inside the high bushfire loss consequence area (SIFIC).

Overhead Asset Repair (AROCO): covers the simple high volume, low complexity tasks where no or minimal design or engineering input is required.

Replace HV Feeders (REHSA): covers small volume, higher complexity tasks, when the nature of the defect(s) necessitates a wider solution taking into account the surrounding feeder and the best long term solution for that section of the network. Usually design is required, and/or some engineering support.

Aerial Inspections (AIOFD) - This program will continue to be the main inspection method identifying crossarm defects and flagging wooden LV crossarms for replacement.

Pole Replacements (REPOL) - This program will continue to replace wooden LV crossarms when poles are replaced.