Investment Evaluation Summary (IES)

Project Details:

Project Name:	Replace Overhead LV Services
Project ID:	00757
Business Segment:	Distribution
Thread:	Connection Assets
CAPEX/OPEX:	CAPEX
Service Classification:	Standard Control
Scope Type:	B
Work Category Code:	SCSRE
Work Category Description:	Replace services OH & service fuses
Preferred Option Description:	Execute a statewide audit to identify defective services and equipment (Program of Work AIOCI). Proactively replace the identified substandard overhead services and equipment, including a 5 year proactive replacement of all 10mm copper services.
Preferred Option Estimate (Dollars $2016/2017):	$13,875,000

	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Unit ($)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Volume	9446.00	9446.00	9446.00	9446.00	9446.00	5000.00	5000.00	5000.00	5000.00	5000.00
Estimate ($)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total ($)	$4,625,000	$4,625,000	$4,625,000	$4,625,000	$4,625,000	$2,500,000	$2,500,000	$2,500,000	$2,500,000	$2,500,000

Governance:

Works Initiator:	Erin Cook	Date:	24/05/2017
Team Leader Endorsed:	Robert Smith	Date:	01/06/2017
Leader Endorsed:	Nicole Eastoe	Date:	30/10/2017
General Manager Approved:	Wayne Tucker	Date:	30/10/2017

Related Documents:

Description	URL
TasNetworks Business Plan 2017-18	http://reclink/R0000779008
NPV SCSRE & AIOCI Replace OH LV Services	http://reclink/R0000725879
Defective Servicing Asset Replacement Rule Base	http://reclink/R0000438070
Brady's Lake Audit Report	http://reclink/R0000731230
Connection Assets Asset Management Plan	http://reclink/R0000300496
Service Replacements Spreadsheet	http://reclink/R0000821062
LV Service Strategy Review	http://reclink/R0000726714
R2A Asset Safety Risk Review - LV Services	http://reclink/R0000751077
TasNetworks 2017-18 to 2021-22 Corporate Plan	http://reclink/R0000745475
TasNetworks Transformation Roadmap 2025	http://Reclink/R0000764285
National Electricity Rules (NER)	http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/Current-Rules
TasNetworks Risk Management Framework	http://Reclink/R0000238142
R2A Risk Management Framework Development	http://reclink/R0000802718

Section 1 (Gated Investment Step 1)

1. Overview

1.1 Background

There are approximately 213,000 overhead low voltage (LV) service wires connected in the TasNetworks distribution network. They consist of the following types:

- 25mm LV ABC Aluminium conductor;
- Open wire copper;
- 10 and 16mm twisted pair copper;
- Figure 8 copper; and
- PVC and twisted copper PVC.

LV service wires represent the highest volume of fault responses on the network. Customer installations also present as having the highest community harm profile. An audit in 2006 identified that approximately 13 per cent of service connection assets, including service wires, fuses and clamps, were in poor condition and required replacement. This audit identified specific asset types that were in poor condition and has resulted in the creation of the defective overhead service replacement rule base as listed in the references. The rule base is used to assess the condition and identify defective servicing assets for replacement whenever crews work on a service asset during other tasks such as pole replacement or staking or LV service wire upgrades.

LV service wire faults can cause the following customer issues:

- flickering lights;
- total loss of supply;
- customer shocks, through broken neutral conductors; and
- possible fire starts.

Records show that there are approximately 20 reported shocks each year that are caused by network owned LV service assets.

LV service assets are not captured in our Spatial Data Warehouse. Therefore, it is unknown how many of each type of LV service wire is in the network. A sample audit of 1000 randomly selected LV service wire was completed in 2015/16, from this it is estimated the volume of 10mm copper services is approximately 21 per cent of installed services. The 2015/16 audit was more comprehensive than the 2006 audit and showed an 8 per cent increase in the number of 10mm services in the network compared to the previous audit. From the 2015/16 audit it is estimated that there is approximately 44,730 10mm copper service wires remaining in the network.

Previously fault data was unable to provide a breakdown of conductor size/type. From July 2016 Inservice fault reports included an asset sub class (conductor type) to enable the capture of LV service wire failures by conductor type. Nine months of reporting shows that 56 per cent of all LV service wire failures are from 10mm copper. This is a significant step change from the 2006 figures, TasNetworks will continue to analyse the data to ensure this is a true reflection of the faults. Whilst TasNetworks does not keep records for LV service wire, it is known the last 10mm service conductor was installed in 1978, therefore the youngest of the fleet will be approaching 40 years with an estimate the oldest may be 55 years. From this information it can be summised the step change is most likely caused by the end of life bathtub curve phenomenon of this asset, therefore failure rates of 10mm service conductors are expected to increase. Analysis of failure mode of 10mm copper has identified moisture ingress due to embrittlement of the insulation due to age allowing for active to neutral flashover. There is increased likelihood of failure after the asset is disturbed so practise has been to replace the service wire whenever the clamp connector is disturbed. The recently identified high failure rate and the ageing of 10mm copper past its end of life indicates a proactive replacement program is required. Included in this work program is the replacement of poor condition and end of asset life service fuses and fittings. Henley 45 amp and Stanger 30 and 55 amp service fuses have been identifed as at end of asset life.

1.2 Investment Need

Existing substandard overhead LV service assets are required to be replaced to reduce the following identified risks to acceptable levels:

- reliability of supply;
- safety of the property owner, the general public and TasNetworks personnel; and
- possible risk of fire to property.

1.3 Customer Needs or Impact

TasNetworks has identified there will be customers whose service mains may be deemed unfit for reconnection due to work carried out during the service replacement. This defect will be triggered by the age of the customers consumer mains and the requirement for replacement of the consumers mains box as part of this work. If the consumers mains are brittle or are ubber or cotton covered conductors, the customer will be required to replace their consumer mains at their expense. To ensure the unfit consumer mains are identified prior to the service replacement, a switchboard audit will be required prior to work commencment. TasNetworks should will need to consider what options may be available to pensioners and other property owners who will not be expecting the expense of the submains replacement.

TasNetworks has undertaken a range of activities to gather feedback, and to understand the issues and concerns that are important to our customers. We have a range of customer, from very large customers directly-connected to our transmission network to large and small customers connected

through our distribution network. TasNetworks continues to undertake customer 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:

- TasNetworks' Business Vision 2025;
- TasNetworks Grid Vision scenarios, including key load, generation and interconnection scenarios;
- New technologies and the future network
- Customer's preferences on service, price and reliability;
- Regulatory Framework including incentive schemes;
- Forecast expenditure programs
- Connections;
- Approach to depreciation; and
- Distribution Pricing Strategies and Methodologies.

Through the engagement, customers have identified that we are meeting most customers' needs from an overall reliability perspective, but for some their needs and expectations are changing especially in regards to safety, restoration of faults/emergencies and reliability of supply. Customers identified TasNetworks needs to provide for their future needs including: affordability, environmentally sustainable, communicative, innovative, efficient and reliable services.

This project specifically addresses the requirements of our customers in the areas of services and Customer's preferences on service, price and reliability.

1.4 Regulatory Considerations

The aspects of the National Electricity Rules (NER) that apply to this project are as follows:

6.5.7 (a) Forecast capital expenditure

(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

Proactive replacement of overhead service assets according to condition and risk based assessment criteria for public safety. This strategy is designed to address the following risks:

- customer shocks, through broken neutral conductors;
- reliability of supply;
- quality of supply; and
- possible fire to buildings.

3. Strategic Alignment

3.1 Business Objectives

Strategic and operational performance objectives relevant to this project are derived from TasNetworks 2017-18 to 2021-22 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 that relate to this project are as follows:

- Safety of our people and the community, while reliably providing network services, is fundamental to the TasNetworks business and remains

our immediate priority; and
- Care for our assets to ensure they deliver safe and reliable network services.

The strategic key performance indicators that will be impacted through undertaking this project are as follows:

- Zero harm – significant and reportable incidents.

The TasNetworks Transformation Roadmap 2025 lists the following for consideration:

- 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; and
- 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.

4. Current Risk Evaluation

Do nothing is not an acceptable option to TasNetworks' risk appetite. The level of risk identified is such that a treatment plan is required to reduce the risks to a tolerable level, in line with TasNetworks' Risk Management Framework.

A risk assessment was completed by R2A risk consultants which relates to a So far as is reasonably practicable (SFARP) approach (see reference 'R2A Asset Safety Risk Review - LV Services'). The key finding of this report was to develop a proactive replacement program.

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	supply interruption or quality of supply issue resulting from failure in service if not replaced in time.	Almost Certain	Negligible	Medium
Network Performance	supply interruption or quality issue resulting from failure in service if not replaced in time.	Almost Certain	Minor	Medium
Safety and People	risk of shock, possible electrocution or fire resulting from failied neutral.	Possible	Severe	High

5. Preferred Option:

The preferred option is the proactive replacement of substandard overhead services.

The strategy also includes some key aspects; execution of statewide audit, proactive replacement of the defective assets identified with a specific portfolio breakdown estimated from audit findings, continued replacement when works needs to be completed.

The proactive replacement of substandard overhead services includes a program to removall all 10mm copper services over 5 years.

The previous LV service strategy has led to the majority of service faults being repaired under fault conditions once they have already failed. This strategy has been determined to be inadequate for addressing the risks surrounding overhead LV service assets. The focus for the new strategy is for the proactive replacement of 10mm copper conductor. This new proactive strategy has been developed to reduce this fault rate, reduce the risk, improve safety and customer satisfaction.

As part of the new proactive strategy, the LV service strategy has been reviewed (LV Service Strategy Review http://reclink/R0000726714) and the strategy going forward is to proactively replace all substandard overhead services. This includes the replace overhead services that have been identified as substandard/poor condition via audits and a 5 year proactive replacement of all 10mm copper services which have been identified as substandard and beyond end of life.

This will involve audits to identify the conductor and to scope the remedial works (project category AIOCI) and revisits for reactivation and replacement works (project category SCSRE). It is anticipated that there will be instances where the 10mm copper is replaced defects will be identified with consumer mains that will be the customers responsibility to remediate.

The risk to public via broken neutral is not influenced by location therefore replacements are to be prioritised by areas longest response time. Areas further away from depots are more expensive to fix under fault due to travel time and also results in a longer period of time public being exposed to risk and increased interruption of supply to a customer. The Works and Service Delivery business unit will determine the most effective way to deliver the audit.

A trial of this strategy was undertaken in the area of Brady's Lake (119 installations). The audits have taken place and the rectification work for the defective services is planned. Of the 119 installations inspected 53 installations where identified require services, fuses and connectors upgraded. The details of this trial can be found in the attached document Brady's Lake Audit Report http://reclink/R0000731230.

5.1 Scope

The work to be undertaken shall be the replacement of substandard overhead services and associated assets as described in R0000438070-Defective Servicing Asset Replacement Rule Base.

Particular methodology to undertake the work:

a) Customer's mains box will be inspected before the start of work to ensure serviceability.

b) Service upgrades will include the renewal of all components from the pole to the customer's main box or equivalent (including service conductor, fuse holder, fuse cartridge and tails into the mains box). The renewal shall also include the refitting of the fascia mounted service hook (anchoring point) as required.

c) Assets are to be replaced as per R0000438070-Defective Servicing Asset Replacement Rule Base.

d) Replacements to be completed according to the Service and Installation Rules and OH line design manual.

e) In addition to work performed, and prior to leaving the site, all connections on a pole and/or point of attachment where work is undertaken shall be checked and tightened/replaced where required, e.g. check the service fuse, mains box, service tails, clamps, visual inspection of transformer neutral earths etc.

f) In addition to work performed a visual inspection of the immediate site shall be undertaken to ensure minimum ground clearance standards are maintained for all overhead conductors.

5.2 Expected outcomes and benefits

This capital expenditure is required to:

- Replace assets that have degraded and are at increased risk of failure; and
- Replace assets before they fail in service (to reduce risk and cost).

5.3 Regulatory Test

Under the current regulatory RIT-D obligations, a Regulatory Investment Test RIT-D may be required for this work program.

6. Options Analysis

Option 0: Do nothing

Run all overhead LV service conductors to failure. Repairs are only performed under fault to restore supply.

Advantages

- Nil.

Disadvantages

- Unacceptable option as does not align with TasNetworks risk appetite;
- Takes no action to mitigate the safety risks surrounding substandard LV services and would require stopping current safety programs and ignoring TasNetworks defective servicing asset replacement rules;
- Does not effectively manage risk of shock or electrocution by continuing to run all assets to failure;
- Likely customer shock or electrocution from failed neutral or exposure to hazardous voltage;.
- Results in unplanned supply interruption when asset fails in service; and
- Replacement costs are higher when done under fault rather than as planned work.

Option 1: Adhoc replacement of substandard services as they are reported through BAU

Advantages

- Takes some action towards reducing the risk of customer shock or electrocution by attempting to replace assets before they fail in service;
- Work fits in with business as usual activities, through ad-hoc identification and proactive replacement; and
- When services are replaced proactively through ad-hoc identification it is more cost effective than running assets to failure and replacing under fault.

Disadvantages

- Based on the age, condition and fault data of the service conductors in the network this is not an acceptable option as it does not align with TasNetworks risk appetite;
- Residual asset risk level of this option is still High;
- Most expensive upfront option due to replacement costs being higher when done under fault rather than as planned work;
- Replacement volumes not high enough to keep up with identified substandard conductors; and
- Not effective in replacing substandard conductor now beyond end of life.

Option 2: Proactively replace substandard overhead services (including program to replace all substandard 10mm copper services over 3 years)

Replace overhead LV service wire or associated equipment that have been identified as substandard/poor condition via audits (AIOCI), including a 3 year proactive replacement of all 10mm copper service wire which have been identified as substandard and beyond end of life. All other defective LV service wires and associated assets will also be proactively replaced however, it is predicted that the find rate for defective LV service wires of varying type will be less.

Advantages

- Reduces risk of customer shock or electrocution by replacing assets before they fail in service;
- Cheaper option than running assets to failure and replacing under fault;
- Enables replacement activities to be prioritised and combined with other tasks to improve efficiency;
- Supply interruption planned and shorter duration;
- Eliminates 10mm copper services, which have been identified as beyond end of life and high risk of failure, from TasNetworks network;
- The proactive 3 year program minimises the likelihood of a failure causing a shock or electrocution.
- Residual asset risk level of this option is Medium (aligned with TasNetworks risk appetite);
- Other defective service assets identified during service replacement will be proactively replaced; and
- Delivery of the program can be achieved.

Disadvantages

- Most expensive proactive upfront option.

Option 3: Proactively replace substandard overhead services (including program to replace all substandard 10mm copper services over 5 years)

Replace overhead LV services wires or all other defective service assets that have been identified as substandard/poor condition via audits (AIOCI), including a 5 year proactive replacement of all 10mm copper service wire which have been identified as substandard and beyond end of life. All other defective assets will also be proactively replaced however, it is predicted that the find rate for defective LV service wires of varying type will be less.

Advantages

- Reduces risk of customer shock or electrocution by replacing assets before they fail in service;
- Cheaper option than running assets to failure and replacing under fault;
- Enables replacement activities to be prioritised and combined with other tasks to improve efficiency;
- Supply interruption planned and shorter duration;
- Eliminates 10mm copper services, which have been identified as beyond end of life and high risk of failure, from TasNetworks network;
- Other defective service assets identified during service replacement will be proactively replaced; and

Disadvantages

- Due diligence assessment indicates to replace 10mm copper services as soon as practical;
- Risk of shock or electrocution is extended for longer than option 2, without being significantly cheaper; and
- Delivery of the program cannot be achieved before all assets fail.

Option 4: Proactively replace substandard overhead services (including program to replace all substandard 10mm copper services over 10 years)

Replace overhead services or all other defective service assets that have been identified as substandard/poor condition via audits (AIOCI), including a 10 year proactive replacement of all 10mm copper services which have been identified as substandard and beyond end of life. All other defective assets will also be proactively replaced however, it is predicted that the find rate for defective LV service wires of varying type will be less.

Advantages

- Eliminates 10mm copper services, which have been identified as beyond end of life and high risk of failure, from TasNetworks network; and
- Other defective service assets identified during service replacement will be proactively replaced.

Disadvantages

- As all services are approaching the end of life in 2017 by 2029 it is estimated all services would have failed in service and therefore a lesser volume would be replaced proactively than the five year option;
- Due diligence assessment indicates to replace 10mm copper services as soon as practical;
- Risk of shock or electrocution is greater with this option; and
- More expensive than option 3 as more services would be replaced under failed conditions.

6.1 Option Summary

Option description	
Option 0	Do nothing.
Option 1	Adhoc replacement of substandard services as they are reported through BAU and under fault.
Option 2	Proactively replace substandard overhead services. Replace overhead services that have been identified as substandard/poor condition via audits (Program of Work AIOCI), including a 3 year proactive replacement of all 10mm copper services which have been identified as substandard and beyond end of life.
Option 3 (preferred)	Execute a statewide audit to identify defective services and equipment (Program of Work AIOCI). Proactively replace the identified substandard overhead services and equipment, including a 5 year proactive replacement of all 10mm copper services.
Option 4	Execute a statewide audit to identify defective services and equipment (Program of Work AIOCI), Proactively replace the identified substandard overhead services and equipment), including a 10 year proactive replacement of all 10mm copper services.

6.2 Summary of Drivers

Option	
Option 0	Public Safety: Poses an unacceptable risk to public safety from an asset failure and is not addressed by this option. Security of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is not addressed by this option. Reliability of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is not addressed by this option.
Option 1	Public Safety: Does not adequately address the level of risk to public safety from an asset failure. Security of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is not addressed by this option. Reliability of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is not addressed by this option.
Option 2	Public Safety: Substandard and poor condition conductor able to be replaced before they fail in service (to reduce risk and cost).

	Security of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is adequately addressed by this option. Reliability of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is adequately addressed by this option.
Option 3 (preferred)	Public Safety: Substandard and poor condition conductor able to be replaced before they fail in service (to reduce risk and cost). Security of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is adequately addressed by this option. Reliability of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is adequately addressed by this option.
Option 4	Public Safety: Substandard and poor condition conductor able to be replaced before they fail in service (to reduce risk and cost). Security of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is not addressed by this option. Reliability of supply: Poses an unacceptable risk to TasNetworks from an asset failure and is not addressed by this option.

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0
Option 1	$24,950,000
Option 2	$41,388,000
Option 3 (preferred)	$13,875,000
Option 4	$31,719,000

6.4 Summary of Risk

This section outlines an overall residual asset risk level, for each of the options.

Option	Risk Assessment
Option 0	Hight
Option 1	High
Option 2	Medium
Option 3	Medium
Option 4	Medium

6.5 Economic analysis

Option	Description	NPV
Option 0	Do nothing.	$0
Option 1	Adhoc replacement of substandard services as they are reported through BAU and under fault.	-$22,423,980
Option 2	Proactively replace substandard overhead services. Replace overhead services that have been identified as substandard/poor condition via audits (Program of Work AIOCI), including a 3 year proactive replacement of all 10mm copper services which have been identified as substandard and beyond end of life.	-$29,288,829
Option 3 (preferred)	Execute a statewide audit to identify defective services and equipment (Program of Work AIOCI). Proactively replace the identified substandard overhead services and equipment, including a 5 year proactive replacement of all 10mm copper services.	-$26,332,448
Option 4	Execute a statewide audit to identify defective services and equipment (Program of Work AIOCI),	-$25,950,689

	Proactively replace the identified substandard overhead services and equipment), including a 10 year proactive replacement of all 10mm copper services.	

6.5.1 Quantitative Risk Analysis

A SLAIRP risk analysis has been completed for this project by the external risk due diligence engineering firm R2A. The outcomes of this report found that the likelyhood of untreated risk is possible and the consequence is severe giving a high risk rating. If a renewal treatment program is undertaken the likelihood is reduced to rare changing the risk rating to medium.

6.5.2 Benchmarking

A review of three other utilities Asset Management Plans for overhead service replacement strategies has identified the following:

1) an increase in shock reports due to neutral failures in services or service connections.

2) All are taking preventive measures for replacement based on condition based assessments.

6.5.3 Expert findings

The R2A Asset Safety Risk Management Framework discussion paper discusses the associated risks of TaNetworks overhead services. Section 4 specifically addresses credible critical isses such as age and broken service neutrals.

6.5.4 Assumptions

CablePI (SCMWA) program will continue to provide neutral integrity monitoring - enabling just in time replacement of service assets as they approach failure.

The cost of unplanned outages is 1.5 times the planned replacement cost.

The asset life of service conductor is 40 years. Based on the bathtub curve, it is likely all will fail by age 55 years.

Replacing assets before they fail in service enables an efficient proactive replacement program that is lower cost than fault response.

Unserved energy was deemed negligible for service conductors in the NPV analysis.