Investment Evaluation Summary (IES)

Project Details:

Project Name:	Low Conductor Span Rectification - Low Clearance LV CAPEX
Project ID:	00545
Business Segment:	Distribution
Thread:	Overhead
CAPEX/OPEX:	CAPEX
Service Classification:	Standard Control
Scope Type:	D
Work Category Code:	RELCR
Work Category Description:	Replace/relocate LV OH (Low Clearance)
Preferred Option Description:	Clear known defect backlog then rectify LV clearance defects identified from LiDAR inspection.
Preferred Option Estimate (Dollars $2016/2017):	$9,398,766

	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Unit ($)	$10,478	$10,478	$10,478	$10,478	$10,478	$10,478	$10,478	$10,478	$10,478	$10,478
Volume	341.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00	139.00
Estimate ($)	$3,572,998	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442
Total ($)	$3,572,998	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442	$1,456,442

Governance:

Works Initiator:	Michael Cooper	Date:	29/05/2017
Team Leader Endorsed:	Darryl Munro	Date:	01/06/2017
Leader Endorsed:	Nicole Eastoe	Date:	24/11/2017
General Manager Approved:	Wayne Tucker	Date:	25/11/2017

Related Documents:

Description	URL
R260427 Conductors and Hardware – Distribution	http://assetzone.tnad.tasnetworks.com.au/strategic-asset-management/Management%20Plans/Forms/AllItems.aspx
National Electricity Rules (NER)	http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/Current-Rules
TasNetworks Risk Management Framework	http://Reclink/R238142
TasNetworks Business Plan 2017-18	http://reclink/R779008
TasNetworks Corporate Plan - Planning period: 2017-18	http://reclink/R745475
TasNetworks Transformation Roadmap 2025	https://www.tasnetworks.com.au/customer-engagement/submissions/
RELCR NPV	http://reclink/R732551

Section 1 (Gated Investment Step 1)

1. Overview

1.1 Background

The provision of adequate clearances of conductor spans is essential for the safe and reliable operation of the distribution network. For the installation of new conductor spans, TasNetworks applies design practices that are consistent with Australian Standard AS/NZ 7000 (see Table 1). The number spans and total installed lengths of different conductor classes present in TasNetworks' distribution network are provided in Table 2. There are currently no records stored on the height of poles, length of particular conductor spans or the tension of conductors in TasNetworks' asset management system.

Table 1: Minimum clearances of conductors at system voltages (AS/NZ 7000 Table 3.6)

TABLE 3.6

MINIMUM CLEARANCE FROM GROUND, LINES OTHER THAN INSULATED SERVICE LINES

Nominal system voltage *U*	Distance to ground in any direction m		
	Over the carriageway of roads	Over land other than the carriageway of roads	Over land which due to its steepness or swampiness is not traversable by vehicles more than 3 m in height
Bare or insulated conductor or any other cable $U \leq 1000$ V	5.5	5.5	4.5
OR			
Insulated conductor with earthed screen $U > 1000$ V			
Insulated conductor without earthed screen $U > 1000$ V	6.0	5.5	4.5
Bare or covered conductor			
1000 V $< U \leq$ 33 kV	6.7	5.5	4.5
33 V $< U \leq$ 132 kV	6.7	6.7	5.5
132 kV $< U \leq$ 275 kV	7.5	7.5	6.0
275 kV $< U \leq$ 330 kV	8.0	8.0	6.7
330 kV $< U \leq$ 400 kV	9.0	9.0	7.5
400 kV $< U \leq$ 500 kV	9.0	9.0	7.5

Table 2: Distribution network approximate span numbers and lengths

Span Type	Number of Spans	Total Length (km)
HV Span	159,818	15,424
LV Span	95,568	4,935
LV Service Span	66,6972	2,096

Note: These numbers only includes service spans between two TasNetworks owned poles.

Through the routine overhead inspection program (AIOHS), TasNetworks' inspectors check the clearances of spans to verify compliance with the standards. Where the conductor spans do not meet the required standards, these defective spans are recorded in TasNetworks' distribution asset inspection system (DAIS) against the pole ID. These spans are then rectified through work categories that TasNetworks has developed for these asset defects. There are four work categories for the rectification of under clearance spans:

1. REHCR – Replace/relocate HV OH (low clearances) (CAPEX);
2. RELCL – Replace/relocate LV OH (building clearances) (CAPEX);
3. RELCR – Replace/relocate LV OH (low clearances) (CAPEX) - This program; and
4. AROLC – Overhead system low conductor clearance rectification (OPEX).

Where an asset defect is identified, rectification is performed through one of the following corrective actions, as appropriate:

1. Where the conductor under clearance is a result of insufficient conductor tension the issue may be resolved by re-tensioning the conductor appropriately.
2. Where the under clearance is a result of sufficient pole height, it may be appropriate to address the under clearance by removing that pole and installing a taller pole.
3. Where the under clearance is caused by a conductor span being too long, it may be appropriate to address the issue by installing an additional pole between the two poles.

Where the under clearance is not the result of any of the above, it may be appropriate and cost effective to remove soil to ensure adequate ground to conductor clearance is re-established.

1.2 Investment Need

TasNetworks has seen a number of incidents where members of the public have had machinery or plant contact conductors, resulting in a network fault which presents a health and safety risk. Although none of these incidents have resulted in injury to members of the public or TasNetworks personnel, it is possible that under a different set of circumstances, serious injury or death would have been incurred. These incidents have all occurred in rural areas, as a result of agricultural machinery or plant contact with overhead lines.

Conductors are installed to the standard of the day in accordance with approved design standards and work practices. In some of these incidents, it has been identified that the conductor clearance is now below the current defined Australian Standard and needs to be brought up to the current standard, as the presence of under clearance conductors presents an unacceptable health and safety risk to the public and as such, TasNetworks in its duty of care obligations, needs to take the appropriate risk mitigation measures to manage these risks.

TasNetworks is implementing a number of actions to mitigate the risk presented by the presence of under clearance span defects in the distribution network with approximately 2,200 under clearance defects identified and recorded to be rectified.

The introduction of an aerial Light Detection and Ranging (LiDAR) program has been designed to rectify this situation and is likely to provide a rise in identified defects after each survey report is received. The aerial LiDAR program is designed to complete a full survey of the network over five years. Until the results of this inspection program are received, there is no knowledge of the extent or severity of the presence of conductor under clearance defects. It is necessary to make assumptions in defining the quantity and necessity of work required to be completed in the 2019-24 regulatory period.

Figure 1 below shows the overall budgeted expenditure for low clearance related programs moving into the next regulatory period. An initial increase in expenditure is event to account for the current backlog and first LiDAR inspection of the network. Subsequent years experience a small oscillation in expenditure in conjunction with ongoing 3 yearly LiDAR inspections.

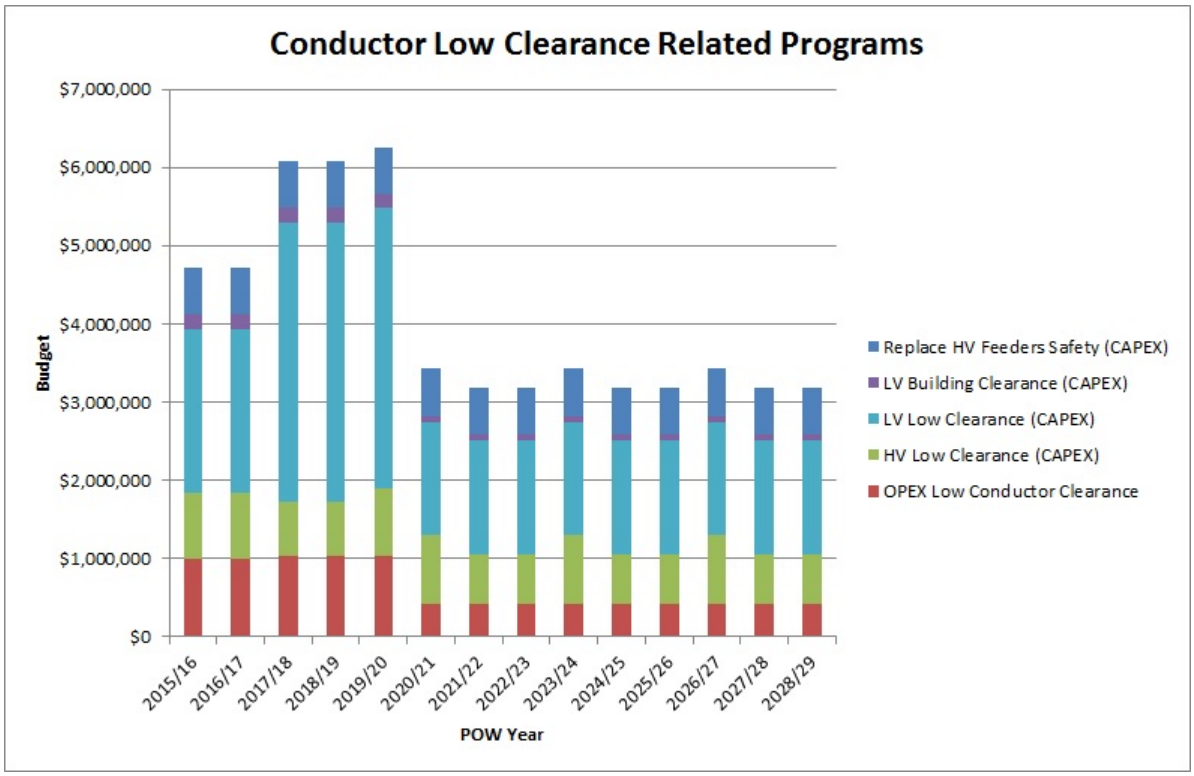

Figure 1 - Budgeted Low clearance spending across all related programs

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 areas of safety, affordability, security of supply and restoration of faults/emergencies.

1.4 Regulatory Considerations

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

The key objectives of this program are to address the health and safety risk to members of the public through the presence of low conductor spans on the overhead low voltage distribution network via:

- rectification (or removal where appropriate) of low conductor span defects currently identified and recorded; and
- rectification of defects identified by the aerial LiDAR inspection program.

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; and
- 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 rectify identified low clearance LV spans there is a risk that a low clearance conductor could result in death or serious injury

to a member of the public or staff.

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	Non-material supply interruption to up to 1000 customers.	Unlikely	Negligible	Low
Network Performance	Increased SAIDI/SAIFI through outage due to conductor contact event.	Unlikely	Negligible	Low
Regulatory Compliance	Low Conductor spans installed to previous design standards will not meet current standards.	Almost Certain	Minor	Medium
Safety and People	Contact of machinery/plant with conductors, resulting in fatality or permanent impairment.	Unlikely	Severe	High

Section 2 (Gated Investment Step 2)

5. Preferred Option:

To mitigate the risk presented by low conductor spans in the distribution network by:

- identifying and classifying the magnitude of the risk presented by these defects currently in the defect pool; and
- managing the risk presented by the population of defective spans through the rectification of these spans appropriately.

As the sag of the lines is proportional to the square of the conductor length, it becomes more important for the conductors to be tensioned correctly as the length of the span increases. Given this critical relationship, it is reasonable to assume, that spans that are longer are more likely to have inadequate clearances. A query was performed on TasNetworks' distribution network asset database, to determine the number of conductor sections that have lengths greater than 180m and 220m respectively. The risk presented by a particular under clearance span is directly related to the frequency at which large machinery or plant passes under the conductors. In consideration of the incidences that have already occurred, the highest risk conductors are those that are located in agricultural areas.

Where sites have been identified as high risk, it is proposed that rectification action be performed immediately (i.e. in the current financial year). Where sites have been identified as moderate risk, it is proposed that rectification action be performed within three years. Where sites have been identified as low risk, it is recommended that action be taken when the asset is otherwise due for replacement or in conjunction with other maintenance tasks.

5.1 Scope

The scope of this work is to rectify the known under clearance asset defects in the distribution network, to appropriately address the risk presented by these defects.

Some additional clearance related defects are anticipated by the addition of aerial LiDAR survey inspections in addition to ground based asset inspection of overhead lines and support structures.

As at August 2017 there are approximately 2,200 under clearance conductor defects recorded in the defect pool, with limited details on the necessity for rectification and the type of work that may be required for rectification. It is proposed that these exisiting recorded defects are rectified over the next three years, with additional defects identified by inspections to be rectified according to their priority/necessity for replacement.

The priority with which these defects are addressed will be determined through a risk assessment process, taking into consideration how far under the minimum clearance the conductor is and the frequency of vehicle access under the span as desribed in section 5 above.

5.2 Expected outcomes and benefits

The expected benefits of this work include:

- a reduction in the safety risk presented by the presence of under clearance conductor spans in the distribution network;
- a reduction in the number of health and safety incidents as a result of low conductor clearance defects;
- improved reliability of the network due to fewer faults associated with low clearances; and
- a reduction in operational expenditure associated with reactive fault reposnse associated with low clearances.

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. Allow defects to remain in the distribution network.
Option 1	Audit 20 per cent of spans per year assuming work will be required on 10 per cent.
Option 2 (preferred)	Clear known defect backlog then rectify LV clearance defects identified from LiDAR inspection.

6.2 Summary of Drivers

Option	
Option 0	Advantages: • Lowest upfront expenditure. Disadvantages: • Unacceptable safety risk to the public; • Repairs and rectification to be carried out under reactive operational expenditure, often more costly; and • Non-compliance of conductors installed to previous standards compared to current Australian Standards remains.
Option 1	Advantages: • All spans are inspected and rectified in the next 10 years; • Safety risk is reduced; • Compliance to current Australian Standards is achieved; • Network reliabillity is improved; and • Minimal operational expenditure required. Disadvantages: • Highest captial expenditure; and • TasNetworks cabability to deliver the program.
Option 2 (preferred)	Advantages: • Safety risk is reduced; • Rectifies identified defects in a suitable timeframe; • Priortised program to address high risk spans first; • Work can be grouped to ensure efficient use of resources; • TasNetworks has cabability to deliver the program; and • Network reliability is improved. Disadvantages: • Some repairs and rectification will be carried out under operational expenditure, often more costly; • Compliance to current Australian Standards is achieved but slower than for option 1.

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0
Option 1	$26,771,290
Option 2 (preferred)	$9,398,766

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:

- Serious injury or death of members of the public as a result of machinery or plant contact with low clearance conductor spans; and
- Inability to make informed decisions as a result of lack of asset defect information.

Option 1 - Audit 20 per cent of spans per year assuming work will be required on 10 per cent:

By auditing 20 per cent and rectifiying 10 per cent of LV spans, the risk is considered Low in accordance with the TasNetworks risk management framework. This evaluation is driven by the greatly reduced likelihood of a under clearance LV span causing injury to the public or staff.

Option 2 - Clear known defect backlog then rectify LV clearance defects identified from LiDAR inspection:

By rectifiying identified under clearance LV spans, the risk is considered Low in accordance with the TasNetworks risk management framework. This evaluation is driven by the greatly reduced likelihood of a under clearance LV span causing injury to the public or staff.

6.5 Economic analysis

Option	Description	NPV
Option 0	Do nothing. Allow defects to remain in the distribution network.	$0
Option 1	Audit 20 per cent of spans per year assuming work will be required on 10 per cent.	-$32,394,848
Option 2 (preferred)	Clear known defect backlog then rectify LV clearance defects identified from LiDAR inspection.	-$10,628,142

6.5.1 Quantitative Risk Analysis

Not Applicable.

6.5.2 Benchmarking

Maintaining clearances in accordance with current required Australian Standards is consistent with asset management practices of other Distribution Network Service Providers.

6.5.3 Expert findings

Not Applicable.

6.5.4 Assumptions

The breakdown between operational expenditure and capital expenditure for low clearance defect rectification is based on a historical analysis which showed that 66 per cent of work is conducted as operational expenditure and the remaining 34 per cent is divided between the relevant capital expenditure programs listed below. This assumes the actual methods used to rectify the defects will not change under this program, and only the volumes will increase as additional defects are identifed by the aerial LiDAR survey.

Related Projects:

Low Conductor Span Rectification - OPEX (AROLC)

Low Conductor Span Rectification Low Clearance HV - CAPEX (REHCR)

Low Conductor Span Rectification Building Clearance LV - CAPEX (RELCL)