Investment Evaluation Summary (IES)

Project Details:

Project Name:	Replace LV Links with Fuse Links
Project ID:	00612
Thread:	Overhead
CAPEX/OPEX:	CAPEX
Service Classification:	Standard Control
Scope Type:	B
Work Category Code:	REOHS
Work Category Description:	Replace OH Switchgear
Preferred Option Description:	Targeted installation of fuse links on 35 % of transformer population, without fuse links.
Preferred Option Estimate (Nominal Dollars):	$977,329

	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27
Unit ($)	$643	$643	$643	$643	$643	$643	$643	$643	$643	$643
Volume	152	152	152	152	152	152	152	152	152	152
Estimate ($)	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733
Total ($)	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733	$97,733

Governance:

Project Initiator:	Jack Terry	**Date:**	25/03/2015
Thread Approved:	David Ellis	**Date:**	02/11/2015
Project Approver:	David Eccles	**Date:**	30/10/2015

Document Details:

Version Number:	1

Related Documents:

Description	URL
NPV Spread sheet	http://teamzone.tnad.tasnetworks.com.au/asset-strategy/Shared%20Documents/DD17/Overhead%20Thread/REOHS%20and%20RERER%20-%20Other%20overhead%20SWGR%20works/Replace%20LV%20Links%20with%20Fuse%20Links%20NPV.xlsm
IES Document	http://teamzone.tnad.tasnetworks.com.au/asset-strategy/Shared%20Documents/DD17/Overhead%20Thread/REOHS%20and%20RERER%20-%20Other%20overhead%20SWGR%20works

	/Investment%20Evaluation%20Summary%20-%20Replace%20LV%20Links%20with%20Fuse%20Links.docx

Section 1 (Gated Investment Step 1)

1. Background

Low Voltage (LV) links are a low cost, high volume asset to allow the isolation and disconnection of distribution transformers, and segments of LV network. TasNetworks has approximately 3600 transformers in the state where LV links are used as the isolation and disconnection device and another 900 transformers where there is no switchgear listed as the LV switchgear type.

Historical Work

Prior to the 12/17 regulatory period, LV links were being incrementally replaced with LV fuse links. A program was included in the 12/17 regulatory submission for the targeted replacement of LV links through the work category REOHQ. This program addresses fuse links that are located in high bushfire consequence areas, and is expected to be completed in this regulatory period. Volumes of work are presented in Table 1.

Table 1: Volumes of fuses to be replaced in 15/16 and 16/17.

Financial Year	Volume
2015/2016	46
2016/2017	50

In the previous regulatory submission, no consideration was given to transformer units that are not located in high bushfire consequence areas.

1.1 Investment Need

1. **Investment Need**

Under fault conditions in the low voltage (LV) network, current is supplied to the faulted elements (earth or phase). In many circumstances, the HV protection is unlikely to detect an LV fault (through the impedance of the transformer), and so the isolation of the fault must occur through the operation of LV protection.

A circuit with LV links installed on the transformer will not be capable of clearing the fault, which may result in conductors melting and falling to the ground, dropping bits of molten metal in the process. If fault current is insufficient to damage the conductor, then the transformer will be significantly overloaded, which may result in the failure of the unit. The presence of LV links in the network therefore presents unacceptable levels of risk with respect to equipment damage, bushfires and public safety.

A circuit with LV fuse links installed will in many cases operate to isolate the fault, which prevents the above events from occurring. Although it is now standard to install fuse links on distribution transformers, previous design and construction standards did not require this.

It is proposed that over the next 10 years, a significant portion (approximately 35%) of the LV link population will be replaced with LV fuse links.

1.2 Customer Needs or Impact

The main impact of this project on the customer is the cost impact through implementation of the project. The selected option provides the greatest net benefit to the business and hence the customer, while adequately mitigating and/or addressing the risk presented by the issue.

1.3 Regulatory Considerations

Not applicable

2. Project Objectives

The proposed project is to implement a targeted program to adequately address the health, safety and environmental risks to members of the public through the presence LV links in the distribution network. It is proposed that over the next 10 years, a significant portion (approximately 35%) of the LV link population will be replaced with LV fuse links.

3. Strategic Alignment

3.1 Business Objectives

Achieving Zero Harm is a key part of enabling TasNetworks to achieve its strategic goal of taking care of its assets, delivering safe and reliable network services while transforming our business. This investment helps achieve this business objective, by mitigating the health, safety and environmental risks presented by the presence of LV links on distribution transformers.

3.2 Business Initiatives

The realisation of condition and risk based asset management capability is central to TasNetworks' strategic initiative of 'One TasNetworks' program. The replacement of LV links with LV fuse links aligns with this strategic initiative through the reduction in risk of conductor and/or transformer failures by providing appropriate LV protection.

4. Current Risk Evaluation

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 follows:

Risk Category	Risk	Likelihood	Consequence	Risk Rating
Financial	Premature failure of assets requires replacement.	Likely	Negligible	Low
Customer				
Regulatory Compliance				
Network Performance	Increased SAIDI/SAIFI through outage as conductor or transformer replacement required	Possible	Negligible	Low
Reputation				
Environment and Community	Starting of bushfire through persisting LV faults.	Rare	Major	Moderate
Safety and People	Serious injury or loss of life of a member of public, through conductor failure	Rare	Major	Moderate

1. **Current Risk Evaluation**

The main risks associated with not undertaking this investment are

1. The serious injury or loss of life of a member of public.
2. Premature failure of overhead assets (transformers and conductors) as a result of persisting faults.
3. Starting of bushfire as a result of persisting faults.

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 follows:

Risk Category	Risk	Likelihood	Consequence	Risk Rating
Environment and Community	Starting of bushfire through persisting LV faults.	Rare	Major	Medium
Financial	Failure of assets (transformers, conductors) under fault conditions is likely to occur, with no LV protection installed.	Possible	Negligible	Low
Network Performance	Increased SAIDI/SAIFI through outage as conductor or transformer replacement required.	Possible	Negligible	Low
Safety and People	Injury or illness that results in >10 days return to work.	Rare	Major	Medium

Section 1 Approvals (Gated Investment Step 1)

Project Initiator:	Jack Terry	**Date:**	25/03/2015
Line Manager:		**Date:**	
Manager (Network Projects) or Group/Business Manager (Non-network projects):		**Date:**	
[Send this signed and endorsed summary to the Capital Works Program Coordinator.]			

Actions			
CWP Project Manager commenced initiation:		**Assigned CW Project Manager:**	
PI notified project initiation commenced:		**Actioned by:**	

Section 2 (Gated Investment Step 2)

5. Preferred Option:

To mitigate the risks presented by LV links in the distribution network, links will be targeted and prioritised according to the risk that they present. Transformers with LV links that are considered appropriate for replacement are those that are greater than 100kVA in capacity (approximately 1520 units). In the absence of detailed information to allow the calculation of probability of a particular transformer causing a bushfire, the risk presented by a transformer is considered to be proportional customers connected, with the risk levels allocated per the following; - High risk, for transformers with equal to or greater than 40 customers connected (507 units). - Moderate risk, for transformers with equal to or greater than 10 customers connected (542 units). - Low risk, for transformers with less than 10 customers connected (471 units). Where sites have been identified as high risk, it is proposed that rectification action be performed immediately (i.e. in the next three financial years). Where sites have been identified as moderate risk, it is proposed that rectification action be performed within 7 years. Where sites have been identified as low risk it is recommended that action be taken, when resources become available.

5.1 Scope

The scope of this work is to replace the LV links on 1520 of the distribution transformers in the state (with LV fused links) to appropriately address the risk presented by the lack of LV protection.

5.2 Expected outcomes and benefits

The expected outcome of this work includes; - Reduction in the number of LV asset failures through the lack of LV protection on distribution transformers. - Reduction in the risk of bushfires through prevention of faults persisting. - Reduction in the health and safety risk to members of the public through conductors melting and falling to the ground.

5.3 Regulatory Test

6. Options Analysis

6. Options Analysis

Option No.	Option description
0.	Do nothing. Allow defects to remain in the distribution network.
1.	Installation of fuse links on 100% of pole top transformers (4370 units).
2.	Installation of fuse links on 70% of pole top transformers (3040 units).
3.	Installation of fuse links on 35% of pole top transformers (1520 units).

OPTIONS SUMMARY

Option description	
Option 0 - Do Nothing	No pro-active action to address the risk presented by lack of distribution transformer LV protection.
Option 1	Targeted installation of fuse links on 100 % of transformer population, without fuse links (4370 units).
Option 2	Targeted installation of fuse links on 70 % of transformer population, without fuse links (3040 units)
Option 3	Targeted installation of fuse links on 35 % of transformer population, without fuse links (1520 units).

Table of Total Costs for each Option

This option matrix provides a comparison of the options against the investment drivers detailed in section 2.

Summary of Drivers	Health and safety	Environment and Community	Minimise cost to customer
Option 0 - Do Nothing	No mitigation	No mitigation	Low Cost
Option 1	Complete mitigation	Complete Mitigation	High Cost
Option 2	Partial mitigation	Partial mitigation	Moderate Cost
Option 3	Partial mitigation	Partial mitigation	Low Cost

ECONOMIC ANALYSIS OF OPTIONS

Option No.	Option description	NPV	Reason got selection/rejection
0	Do nothing. Allow defects to remain in the distribution network.	$0	Unacceptable risk
1	Targeted installation of fuse links on 100 % of transformer population, without fuse links.	-$1,390,180	Excessive cost
2	Targeted installation of fuse links on 70 % of transformer population, without fuse links.	-$770,161	Excessive cost
3	Targeted installation of fuse links on 35 % of transformer population, without fuse links.	-$334,136	Appropriate cost. Adequately addresses risk.

TOTAL COSTS OF EACH OPTION

Option	Total Costs ($)
Option 0	$133,660
Option 1	$1,787,689
Option 2	$1,284,289
Option 3	$708,974

Summary of Risk with selecting Option 0

The main risks associated with selecting option 0 are:

1. Serious injury to or death of members of the public as a result of conductors melting in fault conditions and falling to the ground. Under TasNetworks' risk appetite statement, TasNetworks has no appetite for the death or serious injury of members of the public.
2. Persisting LV network fault results in a bushfire starting causing widespread ecological damage.
3. No reduction in SAIDI by reducing duration of outages as a result of LV faults.

The Preferred option - Option 3

To mitigate the risks presented by LV links in the distribution network, links will be targeted and prioritised according to the risk that they present. Transformers with LV links that are considered appropriate for replacement are those that are greater than 100kVA in capacity (approximately 1520 units). In the absence of detailed information to allow the calculation of probability of a particular transformer causing a bushfire, the risk presented by a transformer is considered to be proportional customers connected, with the risk levels allocated per the following;

- High risk, for transformers with equal to or greater than 40 customers connected (507 units).
- Moderate risk, for transformers with equal to or greater than 10 customers connected (542 units).
- Low risk, for transformers with less than 10 customers connected (471 units).

Where sites have been identified as high risk, it is proposed that rectification action be performed immediately (i.e. in the next three financial years). Where sites have been identified as moderate risk, it is proposed that rectification action be performed within 7 years. Where sites have been identified as low risk it is recommended that action be taken, when resources become available.

The scope of this work is to replace the LV links on distribution transformers equal to or greater than 100kVA in capacity to appropriately address the risk presented by lack of protection on LV links.

Expected outcomes and benefits with prefered option

The expected outcome of this work includes;

- Reduction in the number of LV asset failures through the lack of LV protection on distribution transformers.
- Reduction in the risk of bushfires through prevention of faults persisting.
- Reduction in the health and safety risk to members of the public through conductors melting and falling to the ground.

6.1 Option Summary

Option description	
Option 0	Do nothing
Option 1	Targeted installation of fuse links on 100 % of transformer population, without fuse links.
Option 2	Targeted installation of fuse links on 70 % of transformer population, without fuse links.

Option 3 (preferred)	Targeted installation of fuse links on 35 % of transformer population, without fuse links.

6.2 Summary of Drivers

Option	
Option 0	Safety and people - No mitigation Network performance - No mitigation Financial - No mitigation Environment and Community - No mitigation
Option 1	Safety and people - Complete mitigation Network performance - Complete mitigation Financial - Complete mitigation Environment and Community - Complete mitigation
Option 2	Safety and people - Partial mitigation Network performance - Partial mitigation Financial - Partial mitigation Environment and Community - Partial mitigation
Option 3 (preferred)	Safety and people - Partial mitigation Network performance - Partial mitigation Financial - Partial mitigation Environment and Community - Partial mitigation

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0
Option 1	$2,809,823
Option 2	$1,954,659
Option 3 (preferred)	$977,329

6.4 Summary of Risk

1. **Expected outcomes and benefits**

The expected outcome of this work includes;

- Reduction in the number of LV asset failures through the lack of LV protection on distribution transformers.
- Reduction in the risk of bushfires through prevention of faults persisting.
- Reduction in the health and safety risk to members of the public through conductors melting and falling to the ground.

6.5 Economic analysis

Option	Description	NPV
Option 0	Do nothing	$0
Option 1	Targeted installation of fuse links on 100 % of transformer population, without fuse links.	-$1,390,180
Option 2	Targeted installation of fuse links on 70 % of transformer population, without fuse links.	-$770,161
Option 3 (preferred)	Targeted installation of fuse links on 35 % of transformer population, without fuse links.	-$334,136

6.5.1 Quantitative Risk Analysis

None

6.5.2 Benchmarking

Benchmarking

ENA , which is primarily peers ,many reacting to Victorian Bushfire Royal Commission Findings , recommendations , Victorian Legislation precedents , and the Federal Government sponsoring for the SAA creation of AS 5577-2013 for auditable ALARP .

6.5.3 Expert findings

Expert findings

ENA , which is primarily peers reacting to Victorian Bushfire Royal Commission Findings , recommendations , Victorian Legislation precedents , and the Federal Government sponsoring for the SAA creation of AS 5577-2013 for auditable ALARP .

6.5.4 Assumptions

Total cost of replacing LV links with LV fuse links is $642 for a transformer.

Section 2 Approvals (Gated Investment Step 2)

Project Initiator:	Jack Terry	**Date:**	25/03/2015
Project Manager:		**Date:**	

Actions			
Submitted for CIRT review:		**Actioned by:**	
CIRT outcome:			