Investment Evaluation Summary (IES)

Project Details:

Project Name:	Replace ground mounted transformers
Project ID:	00421
Thread:	Ground Mounted Substations
CAPEX/OPEX:	CAPEX
Service Classification:	Standard Control
Scope Type:	A
Work Category Code:	REGTF
Work Category Description:	Replace Ground Mounted Transformer
Preferred Option Description:	Proactive replacement of transformers at end of life, assessments to be done based on condition information (oil tests).
Preferred Option Estimate (Nominal Dollars):	$2,300,000

	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27
Unit ($)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Volume	4	4	4	4	4	4	4	4	4	4
Estimate ($)										
Total ($)	$230,374	$230,374	$230,374	$230,374	$230,374	$230,374	$230,374	$230,374	$230,374	$230,374

Governance:

Project Initiator:	James Goodger	**Date:**	13/03/2015
Thread Approved:	David Ellis	**Date:**	02/11/2015
Project Approver:	David Ellis	**Date:**	02/11/2015

Document Details:

Version Number:	1

Related Documents:

Description	URL
IES REGTF Replace ground mounted transformer	http://projectzone.tnad.tasnetworks.com.au/business-projects/nis-program/DD17SAM/Deliverables/Ground%20Mounted%20Substations/DRAFT%20IES%20REGTF%20Replace%20Ground%20Mounted%20Transformer.docx

Section 1 (Gated Investment Step 1)

1. Background

There are approximately 1900 ground mounted substations on the distribution network. These substations range in capacity from 300kVA to 4500kVA. Their supply voltage is both are supplied from both 11 and 22kV with a secondary voltage of 400 volts.

The transformers within these substations are located on the ground inside both open and enclosed substations. The substation types comprise building, block wall kiosk, padmount , vault type enclosures and chain wire fence.

Below is the forecasted substation age profile.

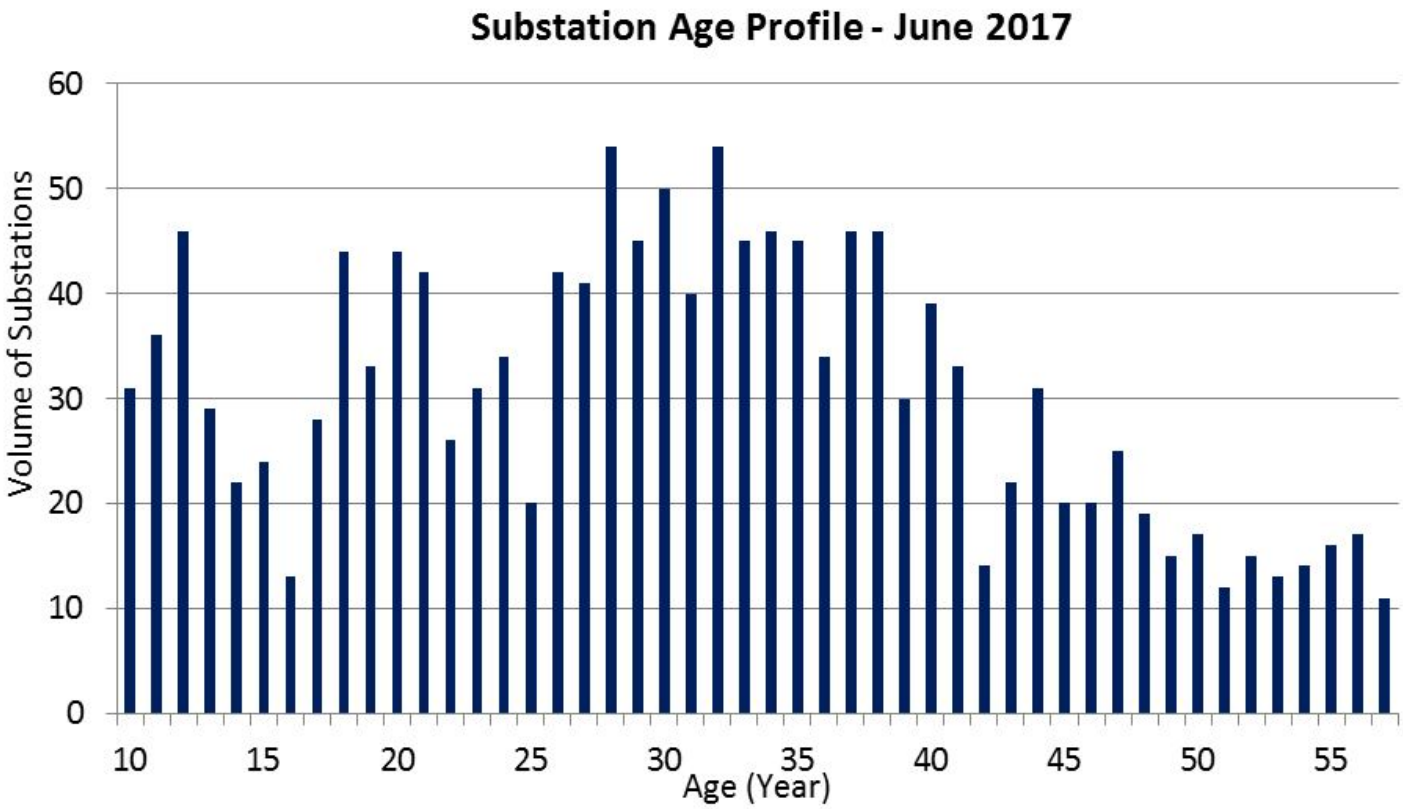
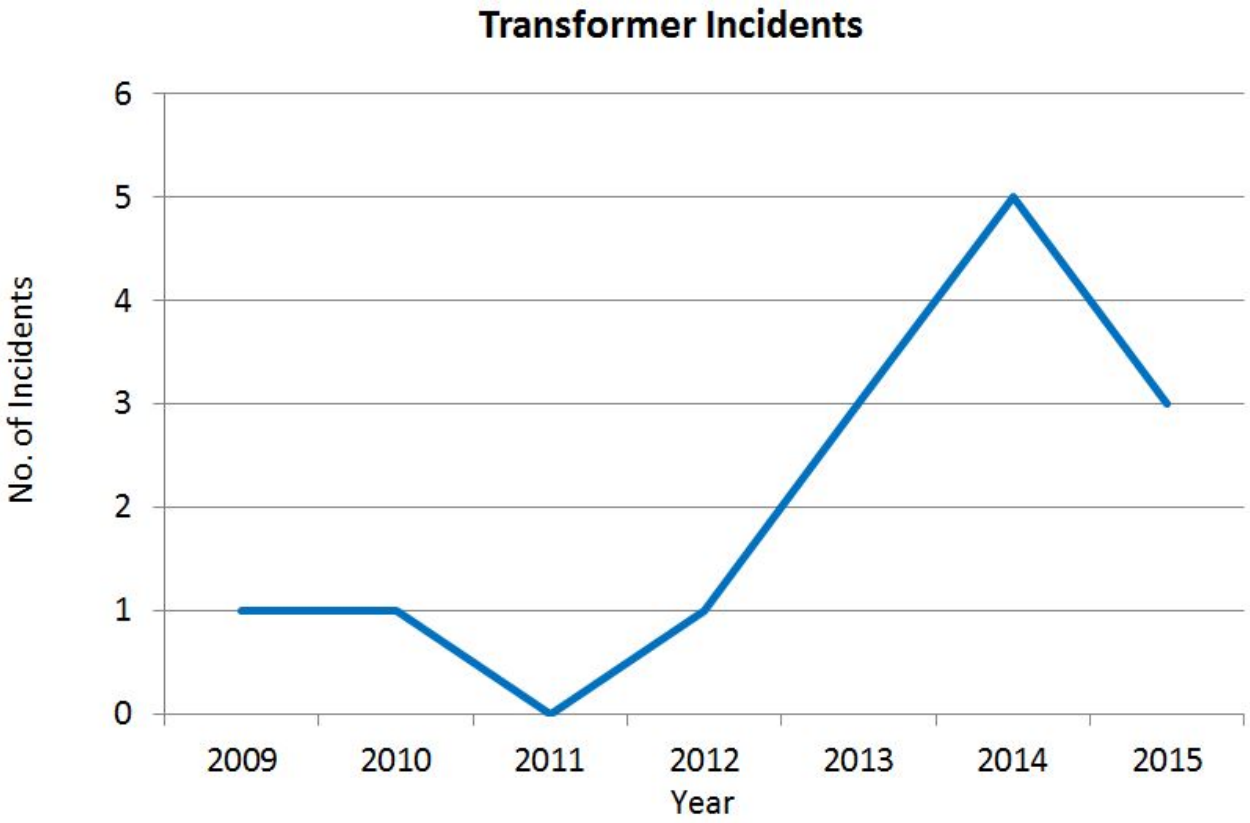


Figure 1 - Projected substation age profile for 2017

1.1 Investment Need



There have been relatively low numbers of faults resulting from transformers recently as can be seen in Figure 2, some of the causes have been: oil leaks due to rust, internal faults due to poor condition, blown bushings and blown fuses. Continued failures such as these have potential for the transformer to create a substation fire where assets and public property may be damaged, oil to leak into unbunded areas and cause environmental damage and also or decrease in network performance if transformer condition isn't managed.

Figure 2 - Significant incidents arisen through transformer faults and failures

The average cost of replacing a transformer in a ground mounted substation is $58k. It is projected that four failure will occur every a year, with an estimated expenditure of $230k per annum to replace the failed units.

The replacement of transformers is targeted at transformers that have reached the end of their service life. The transformers are inspected to confirm that they are in poor condition and require replacement.

1.2 Customer Needs or Impact

TasNetworks continues to undertake a 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)
- Increase 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

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.

1.3 Regulatory Considerations

This project is required to achieve the following capital and operational expenditure objectives as described by the National Electricity Rules section 6.5.7(a) and 6.5.6(a).

6.5.7 (a) Forecast capital expenditure

(1) meet or manage the expected demand for standard control services over that period;

(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 ground mounted transformers in building type substations, when required as determined from condition data or evidence to be in poor condition, or under fault.

3. Strategic Alignment

3.1 Business Objectives

Strategic and operational performance objectives relevant to this project are derived from TasNetworks 2014 Corporate Plan, approved by the board in 2014. 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.
- 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
- We care for our assets to ensure they deliver safe and reliable network services
- We will transform our business with a focus on an appropriate approach to the management and allocation of risk

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

- Price for customers – lowest sustainable prices
- Zero harm – significant and reportable incidents
- Network service performance – outcomes under service target performance incentive schemes
- Sustainable cost reduction – efficient operating and capital expenditure

4. Current Risk Evaluation

If TasNetworks were to do nothing then ground mounted transformers would be run to failure and replaced under fault. The increases failure rate would increase the likelihood of: insulation failure, off load tap changer faults, oil leaking into unbunded areas and transformer failing and causing serious injury or fatality.

The business risk associated with these assets has been evaluated by using the TasNetworks Risk Framework..

The level of risk identified was such that a treatment plan is required to reduce the risk down to a manageable level.

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	Oil leaking into unbunded area due to rusted outdoor transformer (near coastal areas)	Possible	Minor	Low
Network Performance	Insulation failure or off-load tap changer fault	Likely	Moderate	High
Safety and People	Serious injury or fatality due to contact with exposed HV or LV bushings	Rare	Severe	Medium
Safety and People	Transformer insulation failure (or similar), resulting in Fire or Explosion in customer building or build up area	Rare	Severe	Medium

Section 1 Approvals (Gated Investment Step 1)

Project Initiator:	James Goodger	**Date:**	13/03/2015
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:

The preferred option is to proactively replace ground mounted transformers in CBD areas, or building integrated substations, once they reach 60 years of age and have demonstrated to be in poor condition. The preferred option also includes funding for replacing ground mounted transformers under fault. Not proceeding with this option would result in significant system security and capacity issues, resulting in large outages and in extreme cases preventing customer access to the distribution network.

5.1 Scope

The scope consists of:

1. Sites are identified on a year to year basis, based on condition information and reports of safety or environmental issues.
2. Replacement of defective transformer with an equivalent stock item of appropriate voltage and kVA rating.
3. Synergies to be assessed on a site by site basis, e.g. upgrading transformer protection or oil filled switchgear as determined by appropriate risk analysis and schedule for these works.

The allocated budget only covers the transformer replacement and not other related activities e.g. oil; containment Oil containment will be covered under the SIGMS work category.

5.2 Expected outcomes and benefits

The expected outcomes from the preferred option is a reduction of the identified risks, being safety, environmental and network performance. Proactive replacement of transformers when identified as poor condition will reduce the likelihood of failure modes that present a negative or dangerous impact to personnel or the public.

5.3 Regulatory Test

Not applicable

6. Options Analysis

6.1 Option Summary

Option description	
Option 0	Run assets to failure (no proactive replacement)
Option 1 (preferred)	Proactive replacement of transformers at end of life, assessments to be done based on condition information (oil tests).

6.2 Summary of Drivers

Option	
Option 0	Increased reliability, safety and environmental risk.
Option 1 (preferred)	Prevents outages/reliability impacts and potential safety consequences due to in-service transformer failures. Addresses environmental risks (oil leaks) appropriately.

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0
Option 1 (preferred)	$2,300,000

6.4 Summary of Risk

Option 0: Do Nothing

A 'do nothing' approach would result in significant system security and capacity issues, resulting in large outages and in extreme cases preventing customer access to the distribution network. The running of all ground mounted transformers until failure would also increase the probability of a significant failure occurring (transformer fire or explosion).

The risk of fatality or serious injury to personnel or a member of the public is maintained at 'medium' for the short term, as the assets continue to deteriorate that level will reach 'high'.

Option 1: Replace transformer at 60 years of age if condition is confirmed poor [Preferred Option]

This option will maintain network performance, reduce the possibility of oil leaking into unbunded areas, the possibility of transformer insulation failure and safety issues regarding contacting transformer bushings will reduce with proactive replacement.

6.5 Economic analysis

Option	Description	NPV
Option 0	Run assets to failure (no proactive replacement)	$0
Option 1 (preferred)	Proactive replacement of transformers at end of life, assessments to be done based on condition information (oil tests).	$0

6.5.1 Quantitative Risk Analysis

This program is required to prevent ensure ground mounted transformers can be replaced, either proactively (based on condition information) or under fault. A do nothing approach would result in significant system security and capacity issues, resulting in large outages and in extreme cases preventing customer access to the distribution network. Also, running all ground mounted transformers to failure will increase the probability of a catastrophic failure occurring (transformer fire or explosion). While this may be accepted on the overhead network, substations that are integrated with customer buildings or in built up areas exhibit a significant safety risk for these rare failure modes.

6.5.2 Benchmarking

Proactive replacement of critical assets on the network to prevent loss of customer supply is an activity that other distribution networks across Australia also undertake.

6.5.3 Expert findings

Not applicable

6.5.4 Assumptions

There will be sufficient space inside the existing substation for the replacement transformer.

Section 2 Approvals (Gated Investment Step 2)

Project Initiator:	James Goodger	**Date:**	13/03/2015
Project Manager:		**Date:**	

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