Investment Evaluation Summary (IES)

Project Details:

Project Name:	Preemptive Asset Failure Detection Pilot Implementation
Project ID:	02821
Business Segment:	Distribution
Thread:	Innovation
CAPEX/OPEX:	CAPEX
Service Classification:	Standard Control
Scope Type:	A
Work Category Code:	NNNOC
Work Category Description:	Non Network Solutions Network Optimisation Capex
Preferred Option Description:	Implement PAFD pilot program on 7 feeders in HBLCA
Preferred Option Estimate (Dollars $2016/2017):	$500,000

	19/20	20/21	21/22
Unit ($)	N/A	N/A	N/A
Volume	1.00	1.00	1.00
Estimate ($)	N/A	N/A	N/A
Total ($)	$400,000	$50,000	$50,000

Governance:

Works Initiator:	Andrew Fraser	Date:	24/09/2018
Team Leader Endorsed:	Andrew Fraser	Date:	24/09/2018
Leader Endorsed:	Stephen Jarvis	Date:	26/11/2018
General Manager Approved:	Wayne Tucker	Date:	26/11/2018

Related Documents:

Description	URL

Section 1 (Gated Investment Step 1)

1. Overview

1.1 Background

Technology is emerging that allows a shift in asset management practices toward a predictive and proactive asset replacement regime. This technology is commonly referred to as a pre-emptive asset failure detection (PAFD).

This provides TasNetworks an opportunity to reduce the impact on customers and the cost of unplanned outages by identifying network failures before they occur. The technology change requires a change in emphasis in asset management, work practices, technology deployment, and thinking to adequately manage risks and performance.

Obtaining information on the condition of distribution lines is currently a responsive process that is methodically carried out (for example, typically by field patrols and line inspection). These new technical solutions would be capable of remote sensing and reporting of assets in real-time to assist in proactively locating defective assets prior to their failing while still in service.

The PAFD pilot uses new technology to identify emerging issues on our distribution network, thereby enabling a more targeted maintenance regime that prioritises fault avoidance. The technology has been implemented successfully in a number of US Utilities to mitigate significant risks of bushfire, which are similarly prevalent in Tasmania.

The PAFD technology uses waveform pattern analysis of current and voltage waveforms to segregate and characterise normal and abnormal events occurring on distribution lines. The waveform patterns representing abnormal events are often referred to as signatures, generally indicating a failing line component, are characterised and reported as actionable and operator interpretable information via the notification systems like SCADA to asset managers and operations crews to assist in facilitating maintenance or replacement responses.

These signature patterns, which outline a predicted failure mode and the root cause of failure in distribution lines, are still being developed globally with different utilities contributing to build a 'dictionary'. The PAFD pilot aims to install and use the technology on 7 feeders on our network. The priority feeders will be those that have the highest rate of failures in High Bushfire Loss Consequence Area (HBLCA).

That is, enhancing the safety of Tasmanians is the first priority.

The pilot will build a harmonic signature dictionary that predicts failures before they occur and enable TasNetworks to undertake strategic maintenance and replacement activities to avoid failure risks. These failures can be catastrophic when associated with bushfires.

We continue to invest in asset replacement in the HBLCA. This technology aims to maximise that asset replacement investment through identifying the assets that will fail first, and replace them based on condition indicators.

1.2 Investment Need

The first driver of the project is delivering safety benefits for our network and targeting replacement expenditure to avoid catastrophic failures of distribution feeder assets, which can lead to consequences such as bushfires.

The second is aligned directly to the regulatory objective of maintaining the quality, reliability and security of the supply of standard control services. This pilot contributes to improving reliability. Whilst the technology will be targetted towards reducing the cost and risks associated with managing bushfire risk, a secondary benefit will be reducing the number of unplanned outages, thereby improving customer reliability.

In addition to the above, vegetation and challenging topology around our distribution network, including conductor clashing and insulation breakdown are recurring and prevalent causes of distribution fires on our network. These operational problems arise due to limited visibility of our assets' condition and precursor symptoms to major or minor failure. Without PAFD, we are constrained to predicting asset failure without comprehensive asset health data, which significantly increases our operational risk.

Having a PAFD application will help us identify common failures before they occur on our distribution lines; such as bark on line, insulation flashing over due to atmospheric pollution conductor clashing, and thermal overload issues. Hence PAFD application is needed to deliver network investment efficiencies through improving asset management decisions and reducing operational expenditure associated with time-based reactive maintenance.

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, restoration of faults/emergencies and supply reliability.

1.4 Regulatory Considerations

The National Electricity Rules section 6A.6.7(a) sets out the capital expenditure objectives that must be met as part of a revenue proposal.

This project is included in the 2019-24 regulatory submission for TasNetworks in that it maximises overall net market benefits for all customers.

2. Project Objectives

The objectives of the PAFD pilot are:

- Improving the service provided to customers;
- Prove PAFD technology for monitoring feeder condition;
- Reduce risks of network started fires in HBLCAs;
- Improve the reliability of energy supply to customers on the seven pilot feeders;
- Reduce the cost of feeder inspection/ monitoring; and
- Develop learnings for implementation of future automated asset monitoring projects across TasNetworks asset portfolio.

3. Strategic Alignment

3.1 Business Objectives

Strategic and operational performance objectives relevant to this project are derived from the TasNetworks Corporate Plan 2018-19. This project supports the eight objectives to the strategy, included in the corporate plan:

- Focus our teams on customer service and solutions;
- Enhance our customers' experience through the use of technology;
- Build trusting relationships;
- Harness our assets & expertise for the benefit of Tasmania & Australia;
- Reduce total cost of our regulated business;
- Build profitable lines of business;
- Deliver forecast earnings; and
- We operate our business to be sustainable.

The alignment of the proposed project with business objectives are presented below:

Pillar	Objective	Project alignment
Our customers	Focus our teams on customer service and solutions	Implement projects that provide a net market benefit to customers
Our people	Build trusting relationships	Identify and deliver projects that reduce customer costs and deliver where economic to do so
Our business	Harness our assets and expertise for the benefits of Tasmania and Australia	Efficiently constructing assets that provide an economic service to customers
Our owners	Deliver forecast earnings	Deliver projects approved as part of revenue determination
	We operate our business to be sustainable	Implement projects that provide a net market benefit to customers

3.2 Business Initiatives

This is a new program of work and aligns with the following business strategies:

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 TasNetworks business and remains our immediate priority
- We 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:

- Price for customers – lowest sustainable prices
- Zero harm – significant and reportable incidents
- Sustainable cost reduction – efficient operating and capital expenditure

The TasNetworks Transformation Roadmap 2025 lists the following for consideration:

- 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

Bushfire ignition can result in risks to public safety, the environment and network reliability. With a high risk rating associated with ongoing asset failures leading to bushfire ignition, innovative alternatives must be explored to reduce this risk to a tolerable level, in line with 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	Increased disruption to customers connected to the poor performing feeders	Possible	Moderate	Medium
Environment and Community	Increased risk of bushfires in high bushfire loss consequence area	Unlikely	Severe	High
Financial	Low capital efficiency through higher asset replacement schedules	Possible	Moderate	Medium
Network Performance	Interruption of supply to customers (and detrimental power quality)	Unlikely	Minor	Low
Regulatory Compliance	Reduced ability to maintain the quality, reliability and security of the supply of standard control services	Possible	Minor	Low
Reputation	Bushfire and/ or asset failure results in significant media coverage	Rare	Severe	Medium
Safety and People	Bushfire started by poor performing feeders results in a fatality or permanently impairs a person's life (citizen or staff member)	Rare	Severe	Medium

Section 2 (Gated Investment Step 2)

5. Preferred Option:

The preferred option is to implement PAFD technology across 7 feeders as a pilot project.

5.1 Scope

Technology

The PAFD device is a monitoring device connected to substation protection circuits. The hardware meets the industry standards for electrical and environmental robustness compliance requirements that are applicable to similarly connected devices (e.g. common protection relays).

7 Feeders within the HBLCA will be selected based on a combination of greatest connected length, number of historical fire starts, and volume of assets with known fire start failure modes.

The capex cost involved in procuring a DFA unit is approximately $500,000 and involves equipment, sensors and software analytic costs that reside in the respective critical substations to which the 7 worst performing feeders are connected. In addition to the equipment costs, there also costs associated with project management and integration of DFA into our enterprise systems to realise the complete analytical value it brings to our asset management teams.

Process

From a process point of view, there will be multiple change management activities that will need to take place in order to implement a PAFD application and realise the full benefit. A high level scope of activities in order is shown below:

1. Perform necessary research to quantify and develop the detailed scope
2. Perform hardware and software design excluding analytics
3. Procure initial equipment and software
4. Develop Issues / Fault Patterns. Source industry captured signatures to add to the knowledge base
5. Install Equipment
6. Develop and test Analytics including Alarms / Notifications
7. Train NCC and Engineering staff appropriately
8. Optimise solution, procure the remainder of the equipment and software and deploy to other sites

The following high-level process has been developed to guide the installation, and testing of PAFD technology and associated equipment:

1. Install, test and place the equipment and associated analytics into service on the seven worst performing feeders
2. Perform necessary fault simulation exercises in the field to make sure process and technology integrate
3. Modify processes/ design as required

Complete documentation and close activity.

5.2 Expected outcomes and benefits

The implementation of asset failure detection (AFD) technology provides the ability to detect failing assets as they degrade, and prior to the assets ultimately failing causing an outage. Several key asset failure modes provide ignition sources, starting fires that can progress into bushfires. For example, pole top fires can result from failing pin insulators or broken ties.

A failing insulator takes time to progress from the start of failure through to final failure resulting in an outage. The time scale is in the range of weeks to months. The AFD technology detects the failure signature prior to the ultimate asset failure allowing the proactive replacement of that asset ahead of it resulting in a fire start.

The risk cost for each fire start has been determined as $38,000 per fire start, with very conservative consequences. AFD technology costs approximately $50,000 installed on a feeder. The pilot project will select 7 feeders in the high bushfire loss consequence area with large feeder footprints and a history of fire starts. Feeders with greater than two historical fire starts will be selected.

The project will pilot the technology to test the key assumption: fire starts can be prevented through early detection and proactive asset replacement. A business case will be produced to consider implementing the technology across all feeders within the HBLCA area, currently 54 feeders.

The benefits of implementing a PAFD solution across our distribution network include:

1. Improve capital efficiency through improved asset management decisions
2. Reduce bushfire risk profile
3. Reduce network operational expenditure over the long-term
4. Meeting customer expectations and regulatory standards of a safe and secure electricity supply
5. Facilitate enhanced asset management.
6. Improve TasNetworks reliability performance closer to target, and reduce the number of outages and asset down time

The benefits above will have the following business outcomes for TasNetworks that will reduce our future capital and operational expenditure by bringing efficiencies within our asset management process, increase customer satisfaction and upkeep a resilient grid while the energy transition takes place. A number of key outcomes are further detailed below.

Facilitate enhanced asset management

The information available from PAFD can be used to achieve continuous ‘online probable asset condition deterioration’ throughout the entire asset life cycle. This deviates from our current practices of having lagging performance metrics of our feeders, including inability to point out root cause of asset failures. Real time asset condition information would enable each asset class to be assessed and asset decisions made that are based on reliable information at any stage of the asset life cycle. Further, this concept of utilising the PAFD to gather relevant condition data allows for the accurate determination of ‘line asset fitness’. Failure information enables an informed ‘end of life’ replacement CAPEX budget or the prediction of failure during the much longer life-cycle regions of "infant mortality" or the "random failure" periods supporting improved maintenance, targeted rectification works or the application of condition-based maintenance.

Improve efficiency of network capital expenditure through informed asset management decisions.

The ability of the PAFD technology to monitor actual asset condition prior to events, or to minimise a SAIDI event through information accessibility, enables an active and predictive SAIDI management model. The outcome is that we are able to deliver targeted performance improvement at much lower levels of capital and operational expenditure than could have previously been experienced. This will also allow us to defer upcoming capital expenditure on our network, and make strategic decisions about replacement on our assets that truly need replacement based on their condition. The long-term potential impact of PAFD rollout is illustrated below, highlighting that capex and SAIDI are capable of mutual reductions.

Prevent/ reduce asset failure and extend life

PAFD technology enables more targeted replacement capital expenditure by adopting an evidence based 'just in time' approach to asset replacement. This is likely to extend the life of feeders and reduce asset failure as it gives TasNetworks the ability to assess the effectiveness of works undertaken (e.g. repairs following storm events). This enables the effectiveness of maintenance or refurbishments expenditure to be assessed. Additionally, PAFD can be used to actively assess line condition in pre-summer periods to assure TasNetworks that line condition risks are acceptable.

Reducing network operational expenditure through improved predictive replacement

Using information provided by PAFD, the field crews can avoid reactive repair by better asset replacement. Over time, this will minimise the cost of repair and the frequency and duration of outages. Ultimately, using predictive failure information available from the PAFD means repair works can be planned for "blue sky" conditions in normal office hours.

Reducing Bushfire risk profile

The conservative total quatified risk per fire start event is $37,747. Each PAFD feeder has been planned at $50,000 per site. Feeders with greater than 2 historical fire start events will be selected to pilot the technology. Immediate benefits will acrue avoiding asset failures and hence fire starts.

5.3 Regulatory Test

Not Applicable

6. Options Analysis

While TasNetworks expects there to be material savings resulting from implementing PAFD, one of the key the outcomes of the pilot program on the 7 feeders, will be to quantify and confirm the actual financial savings.

6.1 Option Summary

Option description	
Option 0	Do nothing
Option 1 (preferred)	Implement PAFD pilot program on 7 feeders in HBLCA

6.2 Summary of Drivers

Option	
Option 0	
Option 1 (preferred)	Move to proactive "just in time" asset replace base on pre-emptive failure detection.

6.3 Summary of Costs

Option	Total Cost ($)

Option 0	$0
Option 1 (preferred)	$500,000

6.4 Summary of Risk

6.5 Economic analysis

Option	Description	NPV
Option 0	Do nothing	$0
Option 1 (preferred)	Implement PAFD pilot program on 7 feeders in HBLCA	$0

6.5.1 Quantitative Risk Analysis

Not Applicable

6.5.2 Benchmarking

Not Applicable

6.5.3 Expert findings

Not Applicable

6.5.4 Assumptions

Not Applicable