Investment Evaluation Summary (IES)

Project Details:

Project Name:	Automated Asset Condition Identification
Project ID:	02829
Business Segment:	Distribution
Thread:	Innovation
CAPEX/OPEX:	CAPEX
Service Classification:	Standard Control
Scope Type:	C
Work Category Code:	NNNOC
Work Category Description:	Non Network Solutions Network Optimisation Capex
Preferred Option Description:	Implement automated asset condition monitoring on largest sections of CONSAC cable and target replacement
Preferred Option Estimate (Dollars $2016/2017):	$1,000,000

	21/22	22/23	23/24
Unit ($)	N/A	N/A	N/A
Volume	1.00	1.00	1.00
Estimate ($)	N/A	N/A	N/A
Total ($)	$600,000	$200,000	$200,000

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

Asset condition monitoring refers to the process, systems and tools that automate the collection of asset information (e.g. vegetation, temperature or pressure thresholds, conductor clearances, etc.). This online collection of data is then transferred into actionable condition information. It is then the role of the user, in this case TasNetworks, to have the processes in place to effectively leverage condition information to better maintain network assets, both in terms of performance and efficiency outcomes.

Automated condition monitoring should support a strategically planned and implemented maintenance and repex regime appropriate to each asset class, to mitigate the risk of failure. If a maintenance regime is insufficient or neglected, deterioration in asset condition will increase the risk of triggering network events. These range from unscheduled downtime and lost services (best case) to environmental, health, and personal safety impacts (worst case).

A systematic and responsive approach to asset management is the key to mitigating these risks. The first requirement is accurate, up to date information on the current state of assets. Quality information enables predictions to be made and acted on, with a potential to deploy systems to track changes in asset condition. With sufficient knowledge, collected at the right time, maintenance schedules can be updated dynamically to react to the latest trends. Real-time condition monitoring systems can deliver reduced lifecycle costs, while still ensuring that service delivery remains reliable and efficient.

The challenge of automated condition monitoring systems often relate to organisational changes required to respond effectively to changing network situations/ events, rather than the technical ability to identify it in the first place. Early warning of potential failure, via sensitive recognition of pre-cursor behaviour, is the principal aim. Available manpower can then be directed where most needed, armed with details of the current problem and the context of previous failures.

The asset class where condition monitoring is needed to improve reliability, safety and cost efficiency outcomes is Concentric Neutral Solid Aluminium Conductors (CONSAC) low voltage cables. CONSAC cables represents 13 per cent of TasNetworks' low voltage cable network, however they represent 60 per cent of TasNetworks' average low voltage cable failures per annum (total 31). The failure rate of this asset class is disproportionally high.

1.2 Investment Need

The investment need is driven by the need to cost effectively manage the risks associated with CONSAC cable failures. The proposed CONSAC cable replacement program has been reduced by $19.1M over the forward 5 year period, resulting in an increased risk profile associated with the aging cable population. To provide visibility of the ongoing condition deterioration, this project has been proposed as a measure to target the available expenditure to the areas based on a condition measure.

TasNetworks recognises the need to innovate in key areas to achieve greater outcomes for customers. We have identified the costs and risks associated in managing CONSAC cable replacement as a key innovation area.

The investment need is driven by a global trend toward increased automation of asset condition monitoring, as well as targeted requirements within TasNetworks asset base that have a disproportionally high likelihood of failure that can lead to negative consequences. These respective needs are detailed below.

Increased automation of asset condition monitoring

There are a number of trends and forces that are driving utilities to consider automated monitoring:

- Increasing capital expenditure efficiency by adopting 'just in time' asset replacement
- Growing need for reducing operating costs while improving reliability
- An aging grid
- Increasing distribution loads
- Long-term lower operating costs.

Improved monitoring of TasNetworks high risk of failure assets

TasNetworks need to improve asset performance across its CONSAC low voltage cables. This asset type is currently underperforming and requires remediation.

CONSAC failures present a serious public safety risk due to the potential for electric shock. We are currently progressively replacing CONSAC cables and are planning to accelerate this program to replace all CONSAC within our network.

TasNetworks initial submission included accelerated repex programs to replace these high risk of failure assets over the RCP.

The AER's draft determination identified that the CONSAC repex program should be maintained at its current level over the RCP from 2019-24 – 'the preferred approach (representing the greatest net benefit) is TasNetworks' current approach to replace 6km per annum'. They also highlighted that TasNetworks should not assume that recent high failure rates will continue into the future.

Given the AER's draft determination and the underlying condition of this asset class, there is a need to establish an alternate cost effective approach to managing reliability and safety requirements of TasNetworks assets.

Automated asset condition monitoring presents an innovative opportunity to identify asset condition and predict asset failures before they occur. The fundamental change is associated with technology changes, including machine learning, however pilot projects need to be established to develop the corresponding people and process change. This then informs an evidence based approach to asset replacement and its prioritisation.

1.3 Customer Needs or Impact

DNSPs must maximise the utilisation of all assets. Customers, the regulator and service operators are demanding higher levels of availability and reliability, and fewer scheduled outages, while retaining cost competitiveness.

This is driven by outages and response time to outages. TasNetworks is required to ensure that the Tasmanian electricity network performs at an acceptable level of service reliability.

The automated asset condition monitoring pilot will be targeted to CONSAC cables that have the highest customer impact. The determination of impact will be a function of the current reliability profile of operating infrastructure and the number of customers connected to that cable.

Lower prices remain by far the best way to deliver higher customer satisfaction. Its lead as our customers' number one improvement area is growing year on year.

In order to achieve the project objectives, while driving toward lower bills for customers, we require strategic investments in automated technology. However, these technologies and processes need to be tested in a realistic environment to provide assurance that the technology works and is capable of delivering benefits (performance and cost efficiency).

Automated asset condition monitoring, applied to CONSAC low voltage underground cables, presents an opportunity to trial a project that aims to increase the safety and reliability of customer connections, while deferring repex as long as possible.

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 project are:

- Reducing the cost of maintaining the network;
- Manage the risk of lower CONSAC replacement expenditure over the RCP;
- Enable the current BAU approach to CONSAC replacement to continue over the RCP;
- Defer CONSAC cable repex investment;
- Prove automated asset condition monitoring technology for CONSAC;
- Reduce the cost of CONSAC cable inspections; 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.[6] 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

Pillar	Objective	Project alignment
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

Our TasNetworks Transformation Roadmap 2025 identifies business-wide programs that we need to focus on to achieve our strategic goals. This project supports the following transformation programs as set out below:

- Voice of the customer: we anticipate and respond to changing needs of customer and market conditions;
- Network and operations productivity: we'll improve how we deliver the field works programs, continue to seek cost savings and use productivity targets to drive our business;
- Electricity and telecoms network capability: to meet customer 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; and
- Predictable and sustainable pricing: to deliver the lowest sustainable prices, we'll transition our pricing to better able to host the technologies customers are embracing.

4. Current Risk Evaluation

This project aims to address the capital efficiency of CONSAC cable replacement through targetting the replacement program through condition. Under the current replacement regime, which aims to replace all cable over time, does not ensure the cables most likely to fail are replaced first. This project aims to address this, reducing risk and fault replacement costs during the larger 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	Increased disruption to customers connected to CONSAC failure	Possible	Minor	Low
Environment and Community	Negative environmental, health, and personal safety impacts from CONSAC network failure	Unlikely	Major	Medium

Financial	Low capital efficiency by continuing to replace performing assets that have further useful life	Possible	Moderate	Medium
Network Performance	Interruption of supply to household customers (and detrimental power quality)	Unlikely	Minor	Low
Regulatory Compliance	Reduced ability to meet outage and response time standards	Likely	Minor	Medium
Reputation	Poor reliability caused by asset failure results in media coverage	Possible	Negligible	Low
Safety and People	Increased public safety and employee injury events from failing assets	Rare	Major	Medium

5. Preferred Option:

The preferred option is to implement an automated asset and condition identification system.

5.1 Scope

The benefits of automated asset condition monitoring, diagnostics and actions is broadly accepted as the future of network investment and maintenance regimes. While automation technologies, including machine learning, are maturing, network businesses are not experienced in designing, procuring, implementing, or operating these technologies. As such, this pilot seeks to take a step toward automation in an incremental, targeted and controlled manner.

An initial automated asset condition monitoring pilot is proposed to be undertaken on CONSAC underground cable. This is a low cost alternative to replacing the aging and failing CONSAC portfolio. This pilot investment will be used to better identify the 6km of cable to be replaced each year before asset failure occurs. The pilot aims to identify poor asset condition characteristics that indicate a higher probability of failure, enabling TasNetworks to rectify the issue. This may include asset replacement. The pilot will also include a small component of asset monitoring of other ground based assets in substations.

The pilot will involve approximately 50 of 500 transformers (i.e. 10%) within our distribution network that have CONSAC connections. The pilot will require hardware to be installed on transformers and connected to asset management software. During the pilot's inception, criteria will be developed for target network locations. This will likely include targeting CONSAC cable of sufficient length and customer connection, to make the investment commercially beneficial.

The pilot will test:

- Underground cable and ground assets
- The condition of low voltage circuits.

The scope of the project has been separated into people, process, and technology requirements.

People

The impact of this pilot on TasNetworks people will be concentrated on the distribution operations team. Over the next 10 years, this team will need to transition from a fault response operating model to a fault avoidance model. This will require a gradual shift to real-time monitoring and working. The centralised network operators will commence dispatching maintenance crews to rectify issues more efficiently within the pilot period.

The impact will be felt by asset strategy, as well as operational crews in the field. The pilot is unlikely to deliver real-time maintenance for a few years, however it will drive predictive maintenance regimes within the RCP.

The cultural change is likely to be limited to the aforementioned team. In addition to changing working practices, income changes resulting from reduced fault call outs is likely to lead to a level of resistance to change. The transition to automated monitoring is expected to be long enough to support a gradual change process.

Process

A number of key processes are likely to be impacted by this pilot project. While the pilot will contain these impacts to its participants, it is expected that learnings from the pilot will inform future rollouts. Key processes to be impacted include:

- Changing repex investment approach to be based on observed asset condition prior to a failure
- Prioritising CONSAC replacement on poor performing data (as opposed to age or failure).

Technology

The preferred technology is not confirmed at this stage. It will either be bought off the shelf or advanced internally to be fit for application in Tasmanian residential houses. It should be noted that meters inspected by TasNetworks to date have been unable to undertake required cable PI tests for Tasmanian homes. A full assessment will form part of the project in its early stages.

The key investment will be in hardware that can be attached and integrated to distribution network transformers. While automated condition monitoring technology is a maturing market, particularly the machine learning that resides within these technologies, many of the off the shelf solutions are designed for larger assets than CONSAC. This presents the opportunity for a provider, or TasNetworks, to replicate the technology used in many solutions, however scale the hardware to be cost effective for lower value CONSAC cable. Building the hardware in-house will only occur if it is more cost effective.

5.2 Expected outcomes and benefits

Online monitoring and diagnostics is used extensively to monitor key network components, such as cable, feeders and substations. The benefits of automated asset and condition monitoring include:

- Predictive maintenance and targeted capital expenditure
- Life management
- Functional reliability
- Failure cause analysis
- Outage reduction and management
- Reduced operating expenditure
- Enhance safety.

CONSAC cable represents a large replacement expenditure program, with 164km remaining for replacement. Pro-active replacement results in a saving of $12,000 per failure, as the emergency cable jointing to restore supply to customer affected is avoided.

This project proposes to install 85 monitoring devices across the LV systems with the greatest volume of connected CONSAC cables. By targeting these 85 systems, 70km or 43% of cable population can be continually monitored for cable condition deterioration, and proactive replacement of cables can be undertaken, avoiding the emergency jointing costs. As systems are fully replaced, the monitoring device becomes freed up, and can be relocated to new sites

A forward view of asset condition and deterioration rates will enable us to better plan and schedule replacement programs, achieving capital efficiencies. The implementation of this project has allowed the reduction in the overall CONSAC cable replacement program to be reduced from our original proposal, in response to the AER's draft decision. This is a reduction in $19M over 5 years.

Similarly this technology can prove healthy cable, thereby deferring asset replacement. This allows the replacement program to be optimised

A business case to implement the technology across the remaining sites will be completed as an outcome of this project. The technology can be reused across remaining sites as the replacement program progresses.

Online monitoring and diagnostics is used extensively to monitor key network components, such as cable, feeders and substations. The benefits of automated asset and condition monitoring include:

- Predictive maintenance and targeted capital expenditure
- Life management
- Functional reliability
- Failure cause analysis
- Outage reduction and management
- Reduced operating expenditure
- Enhance safety.

Each of these benefits is detailed below.

Predictive maintenance and targeted capital expenditure

Objective: Avoid CONSAC failure and maintenance costs by replacing assets prior to failure.

Justification: While difficult to quantify, online monitoring and diagnostics provides the potential benefit of avoiding equipment failures, which can be very costly in terms of:

- Equipment replacement
- Clean up
- Personnel safety
- Environmental impacts
- Outage impacts.

Online condition monitoring is the only effective solution if the failure characteristic cannot be identified by routine inspection, the failure development time is shorter than the inspection period or the failure characteristics are not predictable in advance.

Life Management

Objective: deferred capital costs by extending the life of old equipment.

Justification: The ability to derive maximum life by accurately monitoring and recording the actual condition of the equipment and then using the information to balance loads in real time and schedule refurbishment in the future. In addition, the information gathered can be used to adjust operating and design practices.

Functional Reliability

Objective: improved reliability/availability to key customers and at key locations in the power system network.

Justification: Assurance that the equipment will function within its design parameters when called upon. This is achieved by early detection of problems. Detection is accomplished with sensors, combined signals for multiple parameters and by using stored historic data and statistical analysis.

Failure Cause Analysis

Objective: opportunity to optimise design and operating practices.

Justification: Online monitoring generates more detailed data that can be used to diagnose the most probable cause of failure or malfunction. Techniques may include fault tree analysis.

Outage Reduction & Management

Objective: avoided emergency asset replacement costs.

Justification: On-line monitoring and diagnostics provides the opportunity to remotely assess the complete condition of the equipment before the outage is booked and a maintenance crew is dispatched.

Follow-up outages can be avoided if the crew is able to conduct the normal inspection and maintenance, and correct additional issues on that or other equipment in the substation. This results in cost savings to the utility and increased availability to the customer.

Enhance safety

Objective: Reduce the number and severity of public safety and employee injury events.

Justification: There are a number of other factors that may impact a decision regarding online monitoring. These are safety, environmental and insurance requirements.

5.3 Regulatory Test

Not Applicable

6. Options Analysis

TasNetworks believes that automated asset condition identification, will not only reduce risk, it will also reduce the impact and cost associated with unplanned outages. TasNetworks estimates that there is a saving of $12,000 per unplanned CONSAC failure.

6.1 Option Summary

Option description	
Option 0	Do nothing- continue to replace CONSAC under current regime.
Option 1 (preferred)	Implement automated asset condition monitoring on largest sections of CONSAC cable and target replacement

6.2 Summary of Drivers

Option	
Option 0	
Option 1 (preferred)	This option is driven by the need to manage the ongoing risks with CONSAC cable operation under a constrained replacement program, with benefits as described in section 5.2

6.3 Summary of Costs

Option	Total Cost ($)
Option 0	$0

Option 1 (preferred)	$1,000,000

6.4 Summary of Risk

The risk associated with ongoing failures within the CONSAC asset replacement program will be reduced by implementing a more accurate and dynamic condition-based replacement approach. This will result in reduced unplanned outages, which means a lower cost and safer service for our customers.

6.5 Economic analysis

Option	Description	NPV
Option 0	Do nothing- continue to replace CONSAC under current regime.	$0
Option 1 (preferred)	Implement automated asset condition monitoring on largest sections of CONSAC cable and target replacement	$0

6.5.1 Quantitative Risk Analysis

As already noted, TasNetworks has accepted a $19 million reduction in its proposed capital replacement program during the 5 year regulatory period on the basis that $1 million is spent in relation to automated asset condition monitoring. As such, the proposed project is warranted, especially as it will deliver safety benefits and longer term learnings that will assist in driving down future costs. A full business case, including NPV analysis, will be developed in due course. At this stage, however, it is evident that the proposed project is highly likely to be assessed as prudent and efficient

6.5.2 Benchmarking

TasNetworks maintains contemporary knowledge of other networks approaches to asset management. In this case TasNetworks has contacted NSW DNSPs to learn from their experience with CONSAC cable monitoring techniques.

6.5.3 Expert findings

Not Applicable

6.5.4 Assumptions

The current advanced meter deployment regime will continue under the power of choice framework, and will not result in sufficient meter penetration in the right locations within the appropriate time frames to allow an effective risk control.