Asset Management Plan

SCADA and Automation – Distribution

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Authorisations

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Responsibilities

This document is the responsibility of the Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Strategy Team Leader with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

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1 Purpose

The purpose of this document is to describe for distribution Supervisory Control and Data Acquisition (SCADA), Automation and related assets:

(a) TasNetworks' approach to asset management, as reflected through its legislative and regulatory obligations and strategic plans;

(b) The key projects and programs underpinning its activities; and

(c) Forecast Capital Expenditure (CAPEX) and Operational Expenditure (OPEX), including the basis upon which these forecasts are derived.

2 Scope

This document covers existing SCADA and Automation assets within the distribution network. It does not cover the primary assets protected or the protection assets; however, it will cover the linkages to the protection assets where appropriate.

It does not cover the SCADA master station and communications medium to connect from the field equipment to the SCADA master station, except where the communication not provided by TasNetworks Communications.

3 Strategic alignment and objectives

This asset management plan is align with both TasNetworks' Asset Management Policy and Strategic Objectives.

This document is part of a suite of documentation that supports the achievement of TasNetworks strategic performance objectives and, in turn, its mission. The asset management plans identify the issues and strategies relating to network system assets and describes the specific activities that need to address the identified issues.

The asset management objectives are to:

(a) manage and meet the strategic goals, measures and initiatives outlined in the Corporate Plan;

(b) comply with relevant legislation, licences, codes of practice, and industry standards ; and

(c) continually adapt, benchmark, improve asset management strategies and practices, and apply contemporary asset management techniques, consistent with industry best practices.

This asset management plan describes the asset management strategies and programs developed to manage the SCADA and Automation system assets, with the aim of achieving these objectives:

(a) Present an overview of the SCADA and Automation system asset populations;

(b) Manage business risk presented by the assets to within acceptable limits;

(c) Achieve reliable asset performance consistent with prescribed service standards;

(d) Assess the risks specific to the assets and identify corresponding risk mitigation strategies;

(e) Ensure the effective and consistent management and coordination of asset management activities relating to the assets throughout their life-cycle;

(f) Ensure our team members are trained, authorised and competent to undertake their work activities;

(g) Demonstrate that the assets are being managed prudently throughout their life-cycle;

(h) Ensure asset management issues and strategies, as they relate to the assets, are taken into account in decision making and planning; and

(i) Define future operational and capital expenditure requirements of the assets.

4 Asset information systems

4.1 Systems

TasNetworks has a number of asset support systems in place to ensure the Distribution SCADA and Automation assets are managed proficiently, listed below:

a) Windows Switchgear Operating System 5 (WSOS5), a software package that facilitates the remote control and monitoring of Schneider Electric pole mounted auto re-closers and load break switches;
b) Control and Management Software (CMS), a configuration, monitoring and control tool used for NOJA Power's Automatic Circuit Re-closers (ACR);
c) DIgSILENT StationWare, a protection and SCADA settings database and management system used to manage the control parameters and to store distribution related information;
d) Purpose-built configurable database tools such as WASP and Distribution WebMap to access secondary asset data such as communications settings and device information. These tools provide real time linkages to TasNetworks' Spatial Data Warehouse (SDW), where various secondary asset data is captured; and
e) System Application and Products (SAP) which is due for release in March 2018, will replace the support system listed in item'd' above.

4.2 Asset information

Asset data information for the distribution SCADA, Automation and related assets has varying availability and quality limitations across the asset portfolio, as summarised in Table 1.

There are a number of initiatives underway such as asset audits and asset information system reviews, which aim to increase TasNetworks' asset data availability and quality. Some asset data, such as the age of zone substation SCADA equipment, this has been based on the most recent modernisation project date.

The SCADA and Automation Distribution Thread is working with the Network Information Systems (NIS) team to increase TasNetworks' secondary asset data availability and quality. An example of this is the development of asset data capture information pertaining to overhead fault indicators, resulting from the associated work program. Another such example is a longer-term project, TasNetworks Integrated Business Solution (TIBS), which aims to fully integrate and improve TasNetworks processes and systems in relation to asset planning, operation and lifecycle management.

Table 1 Secondary asset information summary

Asset Type	Device	Information Availability	Information Quality
Overhead Assets	Fault indicators	Poor	Poor
	Controllers	Average	Average
Ground Mounted	Battery systems	Poor	Poor

Distribution Substation Assets	Controllers	Average	Average
	Fault Indicators	Poor	Average
Zone Substation Assets	Battery systems	Average	Average
	SCADA/control devices	Average	Average

5 Assets description

TasNetworks' manages distribution SCADA and Automation assets pertaining too:

a) 13 major zone substations;
b) 26 sub-transmission feeders;
c) 240 distribution feeders; and
d) Greater than 30,000 distribution substations.

The distribution SCADA and Automation asset class encompasses the secondary SCADA and Automation assets from the Low Voltage (LV) network to the:

e) 22 kV feeder breaker; and
f) 33 kV and 44 kV sub-transmission feeder breakers (excluding).

The primary focus of SCADA systems provide real-time data to monitor the primary equipment within a distribution network, allowing a centralised view of the operation and health of the monitored network. SCADA and Automation systems provide remote control keeping personnel out of danger for safer operation of the primary equipment. The secondary focus is to automate the network for fault isolation and restoration and plant overload schemes. The SCADA system allows primary and secondary equipment faults to be detected early allowing remedial action to be undertaken to ensure assets remain operational for their useful life. SCADA and Automation data allow planners, strategy engineers, operators and maintenance engineers to make informed decisions on how to plan, augment, operate, and maintain the primary and secondary assets.

Due to the distribution network, coverage across the state and being a major determinant of supply reliability there has been a focus on distribution overhead network protection. The higher reliability of underground cabling has required a lesser reliability-based focus with an emphasis on fault detection and clearance design performance requirements.

A typical SCADA system includes of the following components:

(a) Human Machine Interface (HMI) for local operations;

(b) Engineering computer for system access;

(c) Gateway RTU;

(d) Station RTU or distributed Inputs and Outputs (I/O) and Programmable Logic Controller (PLCs);

(e) Global Positioning System (GPS) time synchronisation;

(f) Communication network equipment such as modems, serial servers, routers, network switches, hardware interfaces, media converters and protocol converters;

(g) Intelligent Electronic Devices (IEDs) such as disturbance recorders and power quality monitors;

(h) Data cabling such as optical fibre, cat 5, twisted pair and coaxial; and

(i) Batteries

TasNetworks assets economic lives for are sourced from TasNetworks Regulated Asset Base. In the case of SCADA, network control and protection systems this equates to 15 years.

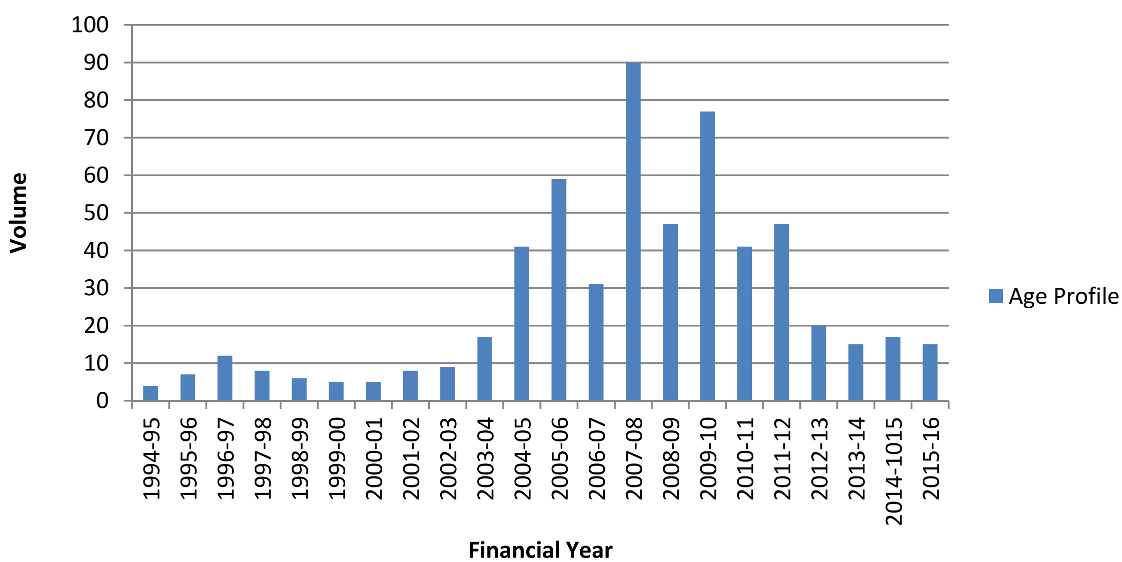
5.1 Overhead assets

Overhead SCADA and Automation control assets listed in Table 2, below. This table outlines that the majority of overhead assets with controllers (Re-closers, Load Break Switches (LBS), Fault Indicators and Voltage Regulators (VR)) where installed during the 2007-2012 regulatory period, and the level of activity pertains to the reliability strategies adopted at the time.

Table 2 Overhead asset volumes

Device	Description	Volume
Re-closers/ load break switch controllers	Schneider and Noja recloser/ load break switch controllers	529
Line Fault indicators	GridSense LT30 and LT40s and CHK RPU4s fault indicators	620
HV voltage regulator controllers	Eaton (Cooper) voltage regulator controllers	33
Total		1182

Figure 1 Overhead asset controller age profile, including re-closers, sectionalisers, LBSs and voltage regulators



TasNetworks re-closer and LBS populations are almost entirely Schneider Electric (Nulec) devices, although TasNetworks has recently secured a supply contract with Noja Power for new devices in the future. Maintenance tasks for the associated controllers include a proactive battery changeovers and the replacement of failed secondary components under fault. Proactive injection testing regimes where introduced in 2012 to ensure the control devices operate as designed and SCADA functionality operated correctly.

TasNetworks' fleet of overhead fault indicators include the CHK RPU3-S4 and the GridSense of which there are 620. Overhead fault indicator asset data is relatively inaccurate in relation to the age, but the proximity type, it is safe to assume that most where installed in the early to mid-1990s, meaning the average age is above 20 years. These devices are fitted with D-cell lead acid batteries and have a maintenance program in place to replace them. Due to a large backlog of devices with dead batteries, this program was accelerated as part of a TasNetworks reliability incentive.

At the time of writing, the last remaining maintenance program aimed at refurnishing the fault indicator batteries is underway, which will facilitate a reduction in outage times and improve fault response capability. Upcoming work programs for the (DD19 period) concerning overhead fault indicators include battery replacements every five years and device replacements for modern SCADA enabled devices where the installed device is proven substandard and unreliable.

High voltage regulators do not have batteries to change out at regular maintenance intervals, but have regular inspection regimes as part of an associated primary asset work program (Substations and Underground Thread). As most of the Cooper regulators now have communications linkages, the SCADA watchdog alarming provides notification of any device anomalies, which are addressed either under fault, or as part of the routine maintenance.

5.2 Ground mounted distribution substation assets

TasNetworks' population of ground-mounted substations are largely serviced by a network of underground distribution feeders. Most underground feeder substations have no SCADA or Automation equipment associated with them.

Ground mounted distribution substation SCADA and Automation asset listed in Table 3 below.

Table 3 Ground mounted distribution substation SCADA and Automation asset volumes

Device	Description	Volume
Auto Change Over	Controllers Auto Change Over	unknown
Automation	Controllers for substation Automation	1
SCADA Control devices	Controllers for substation SCADA	13
Location Fault Indicators (LFI)	Distribution substation controllers	474
Total		~490

TasNetworks has an unknown quantity of ground mounted distribution substation automation schemes. These schemes are utilised to change supply to an alternative supply upon the failure of the primary source of supply. These schemes are found in hospitals, call centre buildings or other high reliability sites. The schemes usually consist of a Programmable Logic Controller (PLC) and battery and are mostly unmonitored presenting reliability issues.

TasNetworks currently has one SCADA driven Automation system to restore supply by utilising Pole Mounted Re-closers (PMRs) and a permanently installed generator. TasNetworks intends it will be installing many more of these schemes to improve network reliability. These schemes will consist of PLCs battery systems and radio system, and are capable of remote monitoring and control.

TasNetworks has a population of 13 automation units, which are installed in Schneider Electric pad-mount substations. The Easergy T200I automation units were retrofitted between 2013 and 2015 and are used by Network Operations as remote-controlled switching points on the distribution network to assist in the restoration of supply. The devices have proven to have issues and do not comply with the Operational Standards. An alternative system that can be retrofitted to all types of pad-mounted or kiosk substations will be developed during the R19 regulatory period based on PLC technology.

Fault indicators are utilised in a significant portion of ground-mounted distribution substations although the exact number is not known due to data quality issues. Of the fleet of 2,200 substations, it is estimated that 22 per cent have fault indication capability, in the form of local visual indication by way of clamped Current Transformers (CTs). After a fault has occurred, these devices activate a visual flag enabling operators on patrol to determine if the substation was on the fault path. These devices are all mechanical in nature, meaning that manual reset of the devices are required post-fault. As part of the upcoming regulatory submission (DD19), TasNetworks intends to proactively replace these devices with the modern equivalent, and some of these will be connected on to the SCADA system.

5.3 Communications

TasNetworks utilises Ethernet over fibre-optic cables for zone substations communications to the Network Operations Control System (NOCS). The pole and ground mounted substations are predominantly serviced by 3G modem/routers, with some equipment being serviced by 900MHz licenced radios. The 3G radios will be obsolete by the end of 2020, a multipurpose replacement is being sourced to replace this equipment that is radio technology independent. The GE Orbit radio/router is being considered as the radio modules can be replaced in situ and support many technologies.

Investigations are underway to interface “Internet of Things” IoT devices such as temperature sensors to monitor primary plant, accelerometers for poles and a myriad of other devices. These devices will be numerous and do not need to be monitored to the same standard as the current “real time” SCADA system. The devices will provide infrequent low volume data to a centralised database. Technologies such as Long Range communication area Network (LoRaWAN) and Telstra 4G Lite are being investigated as possible low cost communications for this data.

Pilot wires, marshalling alarms at East Hobart, West Hobart Zone substations and North Hobart Transmission substation, service ground mounted substations in the Hobart Central Business District (CBD). Fibre optic cables will be replacing the pilot cables has commenced with augmentation work in 2017 the increasing as REPEX work between 2019 and 2029.

5.4 Zone substations

The SCADA system asset category boundary for zone substations is between the protection scheme and the telecommunications circuits connecting to the Network Operations Control System (NOCS). Modern microprocessor based protection relays include SCADA functionality at Bay level for distribution substations.

Modern SCADA systems utilise an Ethernet Local Area Network (LAN) configured as a ring topology to gather the information from the protection schemes and monitoring devices. With the installation of a modern SCADA system, the majority of substations have multiple RTUs in service. This occurs when the existing SCADA system is replaced with a standard system but the protection relays that are not capable of Ethernet communications require the copper wire connections to the old RTU to continue to transfer data. As protection schemes are upgraded, the reliance on the older RTU diminishes until the old RTU can be decommissioned. Generally, the old RTU processor are upgraded to allow it to connect to the new Ethernet as a data concentrator to transfer its data to the new gateway RTU and the interface equipment of the old RTU is left untouched for the legacy protection relays.

Zone substation SCADA and Automation assets listed in Table 4 below.

Table 4 Zone substation asset volumes

Device	Description	Volume
SCADA devices	Zone substation SCADA Gateways	13

TasNetworks' zone substations serve as 33 kV and 44 kV injection points across the distribution network. There are 13 zone substations, with all but Trial Harbour Zone Substation located in the Greater Hobart area.

Whilst many of the zone substations where installed in the 1950s and 1960s, they have undergone significant modernisations over the past fifteen years. Due to limitations in asset data capability, the age of the protection equipment contained in these stations is associated with the most recent modernisation project as per Table 5 below. Zone substation protection relays have integrated SCADA and Automation capability and are configured as Substation Bay controllers.

Table 5 Zone substation age profile

Zone Substation	Voltages	Install Date	Date SCADA System Upgraded	DC Voltage
Geilston Bay	33/11 kV	1964	2001	32 V
Bellerive	33/11 kV	1971	2001	32 V
West Hobart	33/11 kV	1956	2002	125 V
Derwent Park	33/11 kV	1964	2003	32 V
New Town	33/11 kV	1966	2003	32 V
East Hobart	33/11 kV	1958	2004	125 V
Claremont	33/11 kV	1958	2006	125 V
Trial Harbour	44/22 kV	2007	2007	125 V
Cambridge	33/11 kV	2009	2009	125 V
Howrah	33/11 kV	2012	2012	125 V
Sandy Bay	33/11 kV	1967	2014	32 V
Summerleas	33/11 kV	2014	2014	125 V
Rosny	33/11 kV	2015	2015	125 V

TasNetworks has currently standardised on the following SCADA and Automation and protection devices with integrated SCADA installed at zone substations to gain benefits from reduced spares holdings, operator and maintenance staff familiarity and training requirements. In zone substations and Pole mounted re-closers protection relays are utilised as SCADA and Automation devices. The preferred equipment types are detailed in Table 6.

Table 6 Preferred relay types

Description	Manufacturer	Model	Type	SCADA Capable
Automation Device	Schweitzer	SEL2240	SCADA RTAC	Yes
Automation Device	Schweitzer	SEL2411	SCADA RTAC	Yes
Gateway	Cooper	SG-4250	SCADA	Yes
Network Switch	Hirschmann	RSP-35	SCADA	Yes
Engineering PC	Schweitzer	SEL-3355	SCADA	Yes

Description	Manufacturer	Model	Type	SCADA Capable
Firewall	Hirschmann	Eagle 20-400	SCADA	Yes
GPS Clock	Tekron	TCG01G	SCADA	Yes
Line current differential	AREVA/Schneider AREVA/Schneider Siemens Siemens	MiCOM P541 MiCOM P521 7SD610 7SD82	Protection	Yes Yes Yes Yes
Transformer differential	AREVA/Schneider	MiCOM P632	Protection	
11 kV feeder protection	AREVA/Schneider General Electric	MiCOM P143 Multilin SR760	Protection	Yes Yes
Bus couplers	AREVA/Schneider General Electric	MiCOM P143 Multilin SR760	Protection	Yes Yes
SEF check	AREVA/Schneider	MiCOM P122	Protection	No

Table 7 shows the SCADA gateways installed in the 13 Zone substations

Table 7 SCADA gateways installed in the 13 Zone substations

Zone Substation	Manufacturer	Model
Geilston Bay	GE Multilin	D400
Bellerive	GE Multilin	D400
West Hobart	Foxboro	RTU50
Derwent Park	Foxboro	RTU50
New Town	Foxboro	RTU50
East Hobart	Foxboro	RTU50
Claremont	GE Multilin	D400
Trial Harbour	GE Multilin	D400
Cambridge	GE Multilin	D400
Howrah	Foxboro	SCD5200
Sandy Bay	GE Multilin	D400
Summerleas	Foxboro	SCD5200
Rosny	Cooper	SG-4250

Zone substation feeder relays are configured to provide a number of different settings groups including Live Line Settings On/Off, Auto-Reclose On/Off and Under-frequency Load Shedding On/Off. These functions are remotely controlled by the SCADA system.

Battery systems at zone substations are either 32 Volt Direct Current (VDC) or 125 VDC, in accordance with Table 5 above. TasNetworks mostly uses single battery chargers at zone substation sites. The risk in not having full redundancy (a second charger in parallel) has been mitigated by the following:

a) designing batteries to withstand 8 hours on full station load;
b) facilitating rapid deployment of back-up chargers with an external connection pedestal; and
c) adequate spares holdings.

Concerning asset life, the modern batteries used within zone substations are relatively reliable, TasNetworks has moved to a program of replacing the zone substation batteries at ten-year intervals with no annual discharge testing. Any potential savings in life extension by annual discharge testing of the batteries to determine their condition were less than the cost of the discharge testing and battery maintenance.

TasNetworks' distribution SCADA system provides the following functionality:

a) control and monitoring of all circuit breakers;
b) control and monitoring of all transformers and Automatic Voltage Regulators (AVRs);
c) control and monitoring of all protection and metering units;
d) monitoring of all station alarms; and
e) remote indication of metered values and equipment statuses.

The system provides report-by-exception polling operation over the TasNetworks fibre-optic Wide Area Network using Distributed Network Protocol (DNP3) protocol.

The zone substations have HMI stations which facilitate local operation, control, and provide engineering access for engineering staff. In the event that the communication link to the Distribution Control Centre is not operational, all substation alarms, controls and enunciated points are available locally at the substation via the HMI.

SCADA system equipment utilised by TasNetworks consists of various:

a) servers;
b) work stations;
c) gateway RTUs;
d) RTUs;
e) SCADA enabled protection relays;
f) HMI PCs;
g) Engineering computers;
h) Media converters;
i) firewalls;
j) Ethernet switches; and
k) GPS time-clocks.

6 Standards of Service

6.1 Technical Standards

TasNetworks manage a suite of technical standards for each asset category. There are four technical standards applicable for SCADA system assets:

a) R246439 SCADA System Standard
b) R246444 Secondary Systems – General Requirements Standard
c) R246497 Testing, Commissioning and Training Standard; and
d) R231574 Distribution Standard Protection and Control;

6.2 Performance Standards

Performance levels of TasNetworks' SCADA systems assessment is using a combination of internal performance monitoring measures and external benchmarking.

The table below outlines the expected standards for performance of each type of distribution SCADA asset. Note the timing requirements listed are between the field device and the NOC.

Table 8 Expected standards for performance of distribution SCADA assets

Asset Type	Availability		SCADA Polling requirements			
	Maximum Number of outages per annum	Maximum outage time	Poll type	Class 1 Digital	Class 2 Analog	Class 0 Integrity
Zone Substation	1	8 hours	Polled	2 seconds	10 seconds	600 seconds
Ground substation	1	8 hours	Polled	2 seconds	10 seconds	600 seconds
PMR	1	2 days	Exception	Digital input change	Analog change > 10%	12 hours
Sectionaliser	1	2 days	Exception	Digital input change	Analog change > 10%	12 hours
LBS	1	2 days	Exception	Digital input change	Analog change > 10%	12 hours
Kiosk	1	2 days	Exception	Digital input change	Analog change > 10%	12 hours
LFI	1	1 week	Exception	Digital input change	Analog change > 10%	12 hours

6.3 Benchmarking

TasNetworks participates and works closely with distribution companies in key industry forums such as CIGRE (International Council on Large Electric Systems), Institute of Electrical and Electronics Engineers (IEEE), American National Standards Institute (ANSI), and Energy Networks Australia (ENA), to compare asset management practices and performance to ensure we keep abreast of industry good practice and contemporary asset management. In addition, affiliation and representation on Australian Standard and other international standards bodies helps TasNetworks maintain influence on designs and standards and ensure that TasNetworks maintains a strong asset management focus with the objective being continually improvement.

6.4 Key Performance Indicators (KPIs)

TasNetworks monitors distribution assets for major faults through its outage and incident reporting processes.

Asset failures resulting in unplanned outages are recorded in the InService outage management tool by field staff, with cause and consequence information being subsequently made available to staff for reporting and analysis. Asset outages that fall outside of the performance criteria list above are recorded in RMSS and are investigated by the business to establish the root cause of the failure and to recommend remedial strategies to reduce the likelihood of reoccurrence of the failure mode. RMSS holds individual fault investigation reports.

TasNetworks also maintains a defect management system that enables internal performance monitoring and statistical analysis of asset faults and/or defects that either may not result in unplanned outages, or whose failure may only result in a minor consequence not requiring full investigation.

TasNetworks' Service Target Performance Incentive Scheme (STPIS), which meets the requirements of the Australian Energy Regulator's (AER's) Service Standards Guideline, imposes service performance measures and targets onto TasNetworks with a focus on outage duration and frequency. While the STPIS does not target specific asset classes, good asset performance will have a significant impact on TasNetworks' ability to meet the STPIS targets.

STPIS parameters include:

a) System Average Interruption Duration Index (SAIDI); and
b) System Average Interruption Frequency Index (SAIFI).

Details of the STPIS scheme and performance targets are found in the "*Electricity distribution network service providers - Service target performance incentive scheme - November 2009"*.

7 Associated risk

The level of risk pertaining to the SCADA and Automation assets and associated work programs is a function of both likelihood and consequence. Factors affecting the level of risk listed below:

a) age;
b) location;
c) data quality;
d) financial;
e) product support/obsolescence;
f) reputation;
g) monitored devices;
h) regulatory/legal;
i) network performance;
j) safety;
k) environment;
l) customer considerations;
m) trending; and
n) benchmarking.

Risk levels are assessed against the TasNetworks risk management framework, which sets a consistent and structured approach to managing asset-related risk. The assessment of risk against this standard ensures that risk is controlled to a level that aligns with the TasNetworks risk appetite. Any risks which fall outside the permissible limits may require further control in the form of a risk treatment plan and are managed subjectively as required.

For further information relating to the risk levels for the SCADA and Automation asset class (distribution) refer to Appendix A.

7.1 Overhead assets

The overhead SCADA and Automation asset work program risk is generally quite low due to its low complexity and relatively low likelihood/consequence combined risk ratings. Maintenance tasks associated with overhead SCADA and Automation assets are straightforward and managed in accordance with corresponding maintenance intervals.

The program concerning SCADA communications to Cooper voltage regulators is considered low risk as this only relates to a small population of devices across the distribution network.

Communications operating costs are associated with the upkeep of mobile phone network services and is becoming increasingly important in today's operating environment. The risk is therefore considered medium-level.

Table 9 summarises the risk levels for the various work programs pertaining to SCADA and Automation overhead assets:

Table 9 Overhead asset risk

Program	Category	Risk Assessment	Level of risk treated
Operating Costs for Modem Communications	PRCOM	Medium	Low
Replacement of Modem Communications	PRCOM	Medium	Low
Recloser and LBS Maintenance	AROPC	Low	Low
Fault Indicator Maintenance	AROPC	Low	Low
Replace Recloser & or Control Box	RERPC	Low	Low
Install SCADA Communications to Cooper Regulators	PRCOO	Low	Low

7.2 Ground mounted distribution substation assets

The ground mounted distribution substation asset work program mostly concerns maintenance and replacement activities on forty-year old control equipment, largely due to age and locality, the Critical Infrastructure reliability area in the Hobart CBD. The associated risk is considered medium in relation to TasNetworks' risk framework.

Table 10 below summarises the risk levels for the various work programs pertaining to protection and control ground mounted distribution substation assets:

Table 10 Ground mounted distribution substation asset risk

Program	Category	Risk Assessment	Level of risk treated
Routine Maintenance Distribution Subs (Battery System Tests)	RMDPC	Medium	Low
Replace Battery (Once every 4 years same time as per protection test and switchgear maintenance)	REGAU	Medium	Low
Replace Distribution Substation Battery System	REGAU	Medium	Low

7.3 Zone substations

The zone substation asset work program concerns maintenance and replacement programs on the 33/11kV substations across the distribution network. With large levels of customer load and high criticality, medium is the assessed risk for these programs.

Table 11 below summarises the risk levels for the various work programs pertaining to protection and control zone substation assets:

Table 11 Zone substation asset risk

Program	Category	Risk Assessment	Level of risk treated
Urban Zone Substation Protection and SCADA Maintenance	RMZPC	Medium	Low
Battery and Charger Maintenance - Zone Substation	RMZPC	Medium	Low

8 Management plan

8.1 Lifecycle management plan

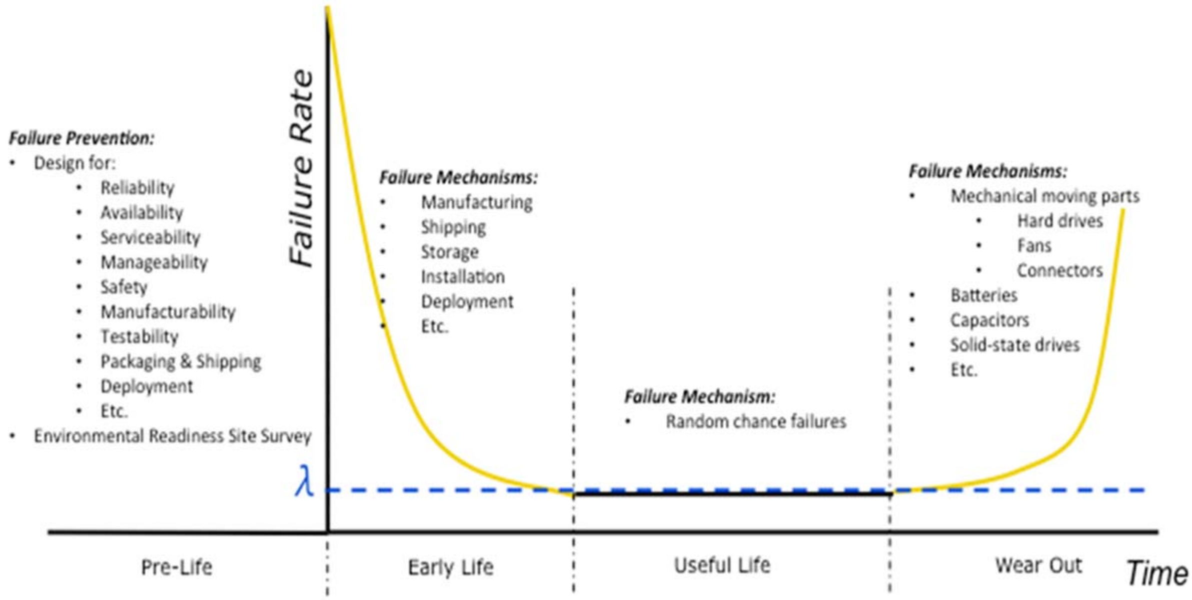
The life-cycle management of distribution SCADA and Automation assets is based on achieving the maximum availability of the asset for the lowest life-cycle cost. This process begins prior to the purchase of the device with standards and designs management to ensure that all assets purchased are specified to fully meet regulatory rules, customer expectations, TasNetworks technical design requirements and constructed to the prescribed TasNetworks standards.

The failure of distribution SCADA and Automation assets can be shown to follow the classic 'bath tub' curve. This implies that equipment is more likely to fail at either the beginning or end of its life. As shown the probability of failure increases exponentially as the asset approaches end of life. Prudent monitoring and maintenance at this critical life stage can help prevent many unplanned outages. Failures which occur at infancy and during the normal lifespan can generally be considered as random failures.

Asset management strategies, techniques and practices are constantly being reviewed and aligned with contemporary asset management principles.

The use of standard designs, configurations and Inspection and Test Plans (ITPs) shall be employed to ensure consistency of designs with design reviews to be carried out every 60 months.

Figure 2 Deriving a probability of failure



8.2 Historical

The SCADA and Automation – Distribution asset thread became detached from the Protection and Control Thread in 2017 and the Overhead and Structures and Substations and Underground threads in 2012. Prior to this SCADA and Automation asset management activities where undertaken under each respective thread whereby most of the initiatives were OPEX and maintenance based. In 2012/13 the maintenance activities pertaining to SCADA and Automation were combined under one thread and additional OPEX and CAPEX-based initiatives were introduced as a new strategic focus began. This included various remote communications programs including substations switchgear and voltage regulators.

Subsequently the spend profile for the SCADA and Automation thread does not precede the 2012/13 financial year.

8.3 Overhead assets

Asset management programs pertaining to overhead (secondary) assets are listed as follows:

Table 12 Overhead protection and control work programs

CAPEX / OPEX	Work Program Level	Project/Program Description	Category Code
OPEX	Non-routine maintenance	Fault Indicator Maintenance	AROPC
CAPEX	Reliability & quality maintained	Replace Recloser & or Control Box	RERPC
CAPEX	SCADA & Network Control	Install SCADA Controls and Communications to Cooper Regulators	PRCOO
CAPEX	SCADA & Network Control	Install SCADA control and communications on metal clad gas insulated pole switches	RERPC

8.4 Communications

8.4.1 Hobart CBD

TasNetworks' (TN) Critical Infrastructure (CI) reliability category as defined by The Office of the Tasmanian Regulator (OTTER) in the Distribution Network Reliability Standards. Section 4.2.1 of this standard refers to a sensitive reliability area within the Hobart Central Business District which comprises a number of important government, private facilities and businesses. The Hobart CBD Critical Infrastructure (CI) zone has several work programs to remedy the current identified risks of an end of life of the pilot wires associated with the unitised protection. This work includes replacement of the protection relays with modern microprocessor based equivalents and repairing or replacing the copper pilot wires with fibre optic cables. The modern microprocessor based relays and repaired pilot cables and fibre optic cables will also provide SCADA functionality to the ground substations in the CI area.

As part of the Hobart CBD planning report, the reestablishment of 11kV feeder rings will for part of the reliability improvement strategy. These 11kV rings will be supply from the East Hobart, West Hobart 11kV Zone substations and North Hobart Transmission substations. The intent with respect to installing new fibre optic communications cables will be to utilise the same trenches as the 11kV cables allowing for SCADA rings to be formed following the 11kV rings from each supply substation. This strategy allows for a simple "cut and shut" operation for both the 11kV and fibre optic cable for future CBD augmentation work.

The existing pilot wires are unreliable and require remediation work to improve safety for TasNetworks staff and contractors. A project has been initiated to address this issue commencing in 2019 with an expected completion date of 2019 as part of this AMP.

The changeover between pilot wires and fibre-optic cable will take ten years to complete. During this changeover period, there will be a combination of pilot wires and fibre-optic cables supplying both 11kV protection and SCADA circuits. The SCADA,P&C and Communications teams will need to work closely to ensure a smooth transition of circuits from pilot wires to regulated fibre-optic cables.

8.4.2 Cybertec 3G Radio Modems

Currently TasNetworks has 646 Cybertec 3G radio modems installed across its fleet of re-closers, sectionalisers, Voltage regulators and Line Fault Indicators. The 3G communications service for these radio modems is supplied by Telstra, which intends to discontinue the 3G service by mid-2020 to be replaced by the 4G network. The project to replace this equipment will straddle the DD17 – DD19 revenue periods, this shall ensure delivery is achieved prior to the 2020 "switch off" date.

Communications technologies are changing at an exponential rate, and typically as at 2017 the changeover rate of technology has reduced from ten to five years. Telstra has announced the release of its 5G product in 2018; this will affect the lifespan of the 4G network. TasNetworks current strategy for SCADA and Automation assets is for a minimum life of 15 years, the rate of change of communication technologies is reducing the lifespan of these products to less than 10 years. These factors place a large financial burden on maintaining communications to an increasing fleet of pole and ground mounted equipment, this in turn increases the risk of failure to deliver the SCADA and Automation services to our stakeholders. A solution to this situation lies with a new range of technologies that are future-proofed against communications technology change, these devices have swappable radio modules allowing for fast changeover to new technology without the need to remove the modem/router module or reprogram the unit. A secondary benefit from using this technology is the ability to change the type of communication utilised based on business need.

For example, if a high reliability/ availability circuit is required the communications module can be changed from Telstra 4G to licenced 900MHz radio without the need to replace the entire modem/radio/ router. The recommended device for this project is the GE MDS Orbit as it has been tested and proven by the TasNetworks communications department.

8.4.3 IoT Communications

Investigations are underway to interface “Internet of Things” devices such as temperature sensors to monitor primary plant, accelerometers for poles and a myriad of other devices. These devices will be numerous and do not need to be monitored to the same standard as the current “real time” SCADA system. The devices will provide infrequent low volume data to a centralised database. Technologies such as LoraWAN and Telstra 4G Lite are being investigated as possible low cost communications for this data.

Table 13 IoT work programs

CAPEX/ OPEX	Work Program Level	Project/Program Description	Category Code
CAPEX	SCADA & Network Control	Replace 3G Cybertec Modems	PRUGA
CAPEX	Communications	Hobart CBD Pilot wire project	REUPC
CAPEX	Communications	Hobart CBD Communication Infrastructure Project	REGAU
OPEX	Operating costs other	Operating Costs for Modem Communications	PRCOM

8.5 Ground mounted distribution substation assets

Asset management programs pertaining to ground-mounted distribution substation (secondary) assets listed in table 14.

Table 14 Ground mounted distribution substation work programs

CAPEX / OPEX	Work Program Level	Project/Program Description	Category Code
OPEX	Routine maintenance	Routine Maintenance Distribution Subs (Battery System Tests)	RMDPC
OPEX	Routine maintenance	Routine Maintenance Distribution Subs (Protection System Tests)	RMDPC
CAPEX	Reliability & quality maintained	Replace Battery (Once every 4 years same time as per protection test and switchgear maintenance)	REGAU
CAPEX	Reliability & quality maintained	Replace Distribution Substation Battery System	REGAU
CAPEX	SCADA & Network Control	Install remotely monitored Fault Indicators	PRUGA
CAPEX	SCADA & Network Control	Automation of Kiosk substations	REGAU

8.6 Zone substation assets

Asset management programs pertaining to zone substation (secondary) assets listed in table 15.

Table 15 Zone substation work programs

CAPEX / OPEX	Work Program Level	Project/Program Description	Category Code
CAPEX	Security	Security and IP camera Project	REUPC
CAPEX	SCADA & Network Control	Claremont Zone HMI upgrade project	REUPC
CAPEX	SCADA & Network Control	Zone HMI installation project	REUPC
CAPEX	SCADA & Network Control	Derwent Park and Newtown Zone AVR replacement	REUPC
CAPEX	SCADA & Network Control	Sandy Bay Zone AVR replacement	REUPC
OPEX	Routine maintenance	Urban Zone Substation Protection and SCADA Maintenance	RMZPC
OPEX	Routine maintenance	Battery and Charger Maintenance - Zone Substation	RMZPC

8.7 Strategy

The asset management strategies pertaining to the distribution SCADA and Automation asset class are described in the subsequent sections.

8.7.1 Hobart CBD

As started in section 8.5 of this document it is intended to establish communication rings that match the 11kV feeder rings within the Hobart CBD CI zone. These rings will initially be a combination of fibre-optic and pilot wire cables forming an Ethernet ring. It is intended to utilise the protection relays with added inputs and outputs points to provide all SCADA functionality within each substation. This eliminates the need to install a SCADA RTU at each sites thereby reducing capital and operation expenditure. Ethernet switches shall be installed in the switchgear at each site to provide communications for the Ethernet ring. Where pilot wires are utilised a 600-600 ohm 15 kiloVolt (kV) pilot isolation transformer and leased line to Ethernet converter will be required.

Three gateways will be required to concentrate the data from all of the Hobart CI substations. These will be established in racks beside the fibre optic communication racks at East and West Hobart Zone substations and North Hobart Transmission substation.

8.7.2 Kiosk substations

Historically ad-hoc works have been conducted with respect to provision of SCADA services for kiosk substations driven by business needs. This work includes:

- Provision of EDMI metering with Cybertec modem in LV end for load monitoring;
- Retrofitting of T200 devices with Cybertec modems in HV end for SCADA indication and control; and
- Retrofitting of Line Fault indication devices with Cybertec modems in HV end for SCADA monitoring.

This ad-hoc strategy has failed to gain a single design to cover all business needs and in some cases, this strategy has allowed two Cybertec modems to be installed on the one site. The EDMI meter is not fit for purpose, as they are a revenue meter without SCADA communications.

A standard single design is required to allow a one or all of the requirements for kiosks SCADA to be delivered at any site. The design shall be based on a single gateway device that is able to marshal the following functions to the NOC,

- LV monitoring for current, voltage, MegaWatts (MW), MegaVars (MVars) and power quality;
- Fault indication; and
- Indication and control of the HV Remote Monitoring Unit (RMU).

In the case of the Schneider Kiosks with RM6 HV switchgear and Masterpact LV switchgear, the following equipment will be required:

- Schneider Masterpact Modbus communications equipment;
- Schneider Flair 23DM fault passage indicators with Modbus communications;
- RTU (gateway) with communications interfaces and I/O (e.g. SEL 2240);
- 4g Modem; and
- Battery and battery charger.

8.7.3 Equipment to be monitored

8.7.3.1 Battery Systems

Recent failures of protection and auto-changeover schemes can be attributed to the poor condition of batteries within Distribution substations in the Hobart and Launceston CBDs. Recent upgrades to battery systems in the Hobart CBD Distribution substations have addressed some of the issues however; these battery systems require monitoring via a SCADA system to ensure the batteries are available when the AC supply fails with alarms sent to the NOC for the following alarms at a minimum:

1) AC Supply failure (delayed by 30 seconds);
2) Low battery volts;
3) High battery volts; and
4) Battery test failure.

A works program is required to ensure all battery systems are monitored by a SCADA system to the NOC.

8.7.3.2 Protection devices

Where watchdog alarms or internal health indications are available for protection devices these are to be monitored by a SCADA system with alarms sent back to the NOC.

8.7.3.3 SCADA and automation systems

SCADA and Automation systems including Auto-changeover systems are to be monitored with alarms sent back to the NOC.

8.7.4 CAPEX versus OPEX

The use of SCADA and Automation systems for control and monitoring of primary and secondary assets provides opportunities to trade operating expenses for capital investment effectively. Remote controlling or automating distribution network devices for network control, automated fault isolation and restoration, plant overload schemes and automatic voltage regulation and Var control can provide significant savings in operational costs and manual switching. The SCADA and Automation thread works closely with Network Innovation in actively seeking these opportunities.

SCADA and automation is most cost effectively introduced through new equipment with factory fitted capabilities, and is becoming a common feature of new switchgear. TasNetworks expects this to be a standard feature of all new switchgear, and considers these features when renewing switchgear supply period contracts.

The SCADA and Automation Thread is also taking the opportunity to capitalise the replacement of batteries in distribution substations by introducing a cyclic replacement program, as an alternative to performing routine battery testing. This aligns with a key TasNetworks strategic focus in meeting customer needs at the lowest sustainable cost.

A cyclic battery replacement program for zone substations has also recently been introduced to the Program of Work, to reduce operational expenditure associated with routine testing.

8.7.5 Replace versus retrofit

The implementation of SCADA and automation systems for zone and distribution substations, re-closers, switches and regulators can be achieved through either retrofitting of equipment or replacement with equipment that has the facilities to achieve SCADA and Automation functionality.

Where switchgear can be retrofitted with motorised spring chargers to provide remote control functionality (certain Schneider and Brown Boveri switchgear), they will be investigated as potential remote control projects associated under the SCADA and Automation POW. New and emerging remote control technologies are first Lab tested for suitability under Network Innovations' work programs, then trialled and developed into standard packages for use in the distribution network.

Where retrofitting is not an option then remote control is implemented when asset management requirements necessitate asset replacement. This is carried out in conjunction with the Substations and Underground Thread.

8.7.6 Routine maintenance

As part of routine protection testing SCADA alarms shall be tested back to the NOC.

8.7.7 Condition Based Assessments

A project to investigate the benefits of utilising internal temperatures and power supply rail voltages in "Real time" to assist with predicting condition and forecasting failures shall be undertaken during the 2019-24 period. Learnings from this investigation shall be utilised to form a detailed Condition Based Reporting Mechanism for all secondary assets for implementation between 2025 and 2029.

As part of routine protection testing SCADA alarms shall be tested back to the NOC.

8.7.8 Corrective maintenance

Distribution SCADA and Automation asset failures do not cause serious or catastrophic damage to the associated primary asset. Therefore, failures do not represent a significant risk to the public and surrounding infrastructure. Accordingly, a corrective maintenance program represents the most cost effective maintenance program.

8.7.9 Refurbishment

Where distribution SCADA and Automation assets are removed from the network in good operating condition by activities such as augmentation, these assets are assessed for redeployment back into the network where such refurbishment is deemed an economic proposition.

8.7.10 Planned asset replacement versus reactive asset replacement

A reactive replacement generally does not represent an attractive alternative to a planned renewal activity. Distribution SCADA and Automation assets are predominately servicing high density urban, commercial or CBD communities, with a high service level expectation in the Tasmanian Electricity Code. Reactive replacements are generally several times more expensive, incurring overtime; call out penalties and additional repair costs. Therefore, a proactive planned replacement regime is preferred to a run to failure strategy.

Replacement is generally only preferred when this is an economic proposition compared to ongoing maintenance costs over the estimated remaining service life of the asset. These are identified from the maintenance and inspections activities and feed into the list of proposed capital expenditure projects for prioritisation.

8.7.11 Standardisation

TasNetworks has standardised on a smaller number of SCADA and Automation models to reduce the overheads associated with maintaining a diverse range of equipment but currently do not have period supply contracts for SCADA or Automation equipment. A standard SCADA panel design has been developed for the Transmission SCADA gateway. These drawings shall be adapted for the zone substation gateway. Standard scheme designs are required for aspects of distribution SCADA and Automation. The standard scheme designs must not be modified until a review of the associated technical standard is performed which is undertaken on a 60-month cycle. For standardisation of SCADA and Automation to be successful, the designs must integrate with all primary designs. Therefore, the primary designs must also be standardised. Standard schemes shall be developed for all SCADA and Automation applications, including but not limited to the list below:

1) Gateway Panel;
2) Pole Mounted Re-closers and Sectionalisers (from manufacturer);
3) Pole mounted LFIs;
4) Kiosk SCADA (control, LFI, Metering); and
5) Automation scheme controllers (Auto-restore, generation control etc.);

8.7.11.1 Standard Templates

Each standard panel design shall be accompanied with standard templates for each implementation including the following:

a) Standard drawings;
b) Standard setting files;
c) Standard ITPs, SCADA and Automation test plans and associated documentation;
d) Design Manuals;
e) Training Manuals;
f) Construction and maintenance manuals; and
g) OEM documentation.

8.7.11.2 Standard Modules

To assist in capital works delivery standard modules shall be developed for primary and secondary assets. This will tie to standard protection panels and templates to standard primary designs. These designs can then be costed, and become standard building blocks to be used by the business. The time and effort required to develop detailed functional and technical specifications shall be reduced as standard designs and documentation will be utilised. The cost and time to deliver detailed estimates will be reduced, as costs shall already be quantified.

8.7.11.3 Standard Panel Manufacture

TasNetworks shall administer the local manufacture of standard panels to reduce costs, improve consistency and allow period contracts to be formed with relay vendors. The added benefit of the period contracts is to form closer relationships and gain improved support vendors. As the amount of REPEX work between 2017 and 2019 has been quantified, panel quantities can be assessed and manufactured in batches to reduce costs. The added benefit is TasNetworks will be a good corporate citizen by employing local labour to manufacture the panels.

Once manufactured the panels can be Factory Acceptance Tested (FAT) in the P&C Lab using the standard settings template reducing the amount of Site Acceptance Testing (SAT) required on site, as only the site-specific settings and equipment connections will require testing.

These panels can be free issued as part of project work reducing the cost and times associated with design and manufacturing. The added benefit assisting in the delivery of capital works projects.

8.7.12 Non network solutions

SCADA and Automation equipment, forms part of the Network Innovation team's portfolio, they spend considerable time evaluating new and emerging technologies. The SCADA and Automation Thread work closely with the Network Innovation team in this regard to ensure the innovation can be aligned with the SCADA and Automation strategy and asset management plan.

The introduction of some non-network solutions such as embedded generation require SCADA and Automation systems to effectively operate on the power network. Network Innovation and Strategic Asset Management will jointly manage this issue.

8.7.13 New technology

Modern protection systems, through their implementation in microprocessor-controlled relays, are changing rapidly with new technological improvements. Protection devices now include SCADA and Automation functionality. New technology such as IEC61850 will continue to be investigated by TasNetworks for distribution use and implemented where cost/benefits exist.

8.8 Routine maintenance

The following sections outline the routine maintenance programs for this asset class.

8.8.1 Urban zone substation protection and SCADA maintenance - RMZPC

This operational program concerns the maintenance activities associated with SCADA systems at TasNetworks' 13 zone substations. Activities include:

a) device setting back-up;
b) spares management;
c) software version control and licensing management;
d) equipment calibration;
e) visual checks and inspections;
f) cleaning of secondary equipment;
g) fault response;
h) incident investigations; and
i) ad-hoc works.

The maintenance intervals for these activities vary between monthly to four-yearly in accordance with the following table:

Table 16 Zone substation maintenance intervals

Classification	Frequency
Calibration	Every four years
Device setting back-up, cleaning, software	Twelve-monthly
Inspections, checks	Monthly
Fault response, ad-hoc works, investigations	As required

Until August 2015 the entire program services were provided by an external contractor, selected through a competitive tender process. Following the recent merger, in-house expertise was gained allowing these activities to be provided internally minus fault response and some ad-hoc works.

Since the advent of numerical relays with watchdog alarming, the opportunity exists to extend maintenance intervals. Whilst the opportunity exists to push injection testing regimes out further, TasNetworks considers four-yearly intervals the most appropriate maintenance frequency since the associated primary equipment (CTs and VTs) are all-original, having not been replaced as part of any recent modernisation projects.

This program has been developed to manage associated asset risk in accordance with TasNetworks' risk framework, and is an essential program in ensuring the ongoing protection of all associated primary equipment.

8.9 Corrective maintenance (OPEX)

The following sections outline the non-routine maintenance programs for this asset class.

8.9.1 Recloser and LBS maintenance - AROPC

This operational program relates to the replacement of batteries in recloser and load break switch controllers on a five-year cycle. The recloser/LBS fleet in the distribution network is divided evenly across the five-year maintenance period in accordance with locality. This enables efficient use of resources in delivering this program.

This program is essential in safeguarding recloser/LBS devices from failing in service, especially re-closers that have important protection functions. It has been developed in accordance with TasNetworks' risk framework.

8.9.2 Asset repair OH protection switchgear maintenance - AROPC

This operational program concerns the activities associated with the repair of re-closers and load break switches (excluding primary equipment). Activities include the repair of control cabling, circuit boards, power supplies, communications equipment and fusing.

This work is mostly reactive and is performed as equipment fails in service. Volumes are based on historical figures. This program has been developed in accordance with TasNetworks' risk framework.

8.9.3 Fault indicator maintenance - AROPC

Fault indicator maintenance program (OPEX) is related to the replacement of batteries on a five-year cycle. Other activities include modifying connections to facilitate a faster battery changeover and cleaning the device solar panel.

TasNetworks has two types of overhead proximity fault indicator:

a) CHK RPU3-S4; and
b) GridSense LT 30.

This program has been developed to ensure the ongoing reliability of the overhead fault indicator fleet. These devices are instrumental in reducing outage times because of extended fault patrols. The program been developed in accordance with TasNetworks' risk framework.

8.10 Operating costs other

8.10.1 Operating costs for modem communications - PRCOM

This program provides operational expenditure to cover account charges for protection and control Next-G communications devices. Distribution network equipment utilising remote communications devices are as follows:

a) re-closers;
b) load break switches;
c) fault indicators;
d) capacitor banks;
e) fuse savers;
f) voltage regulators; and
g) ground-mounted substations.

TasNetworks utilises Telstra Next-G at present, and has recently moved from simple dial-up communications to 'always on' wireless IP communications. This has a marginal cost increase but it provides a significant performance increase and additional functional benefits.

8.11 Reliability and quality maintained (REPEX)

The following sections outline the 'reliability and quality maintained' programs for this asset class.

8.11.1 Replace recloser and/or control box - RERPC

This capital program is a reactive program developed to substitute damaged or faulty controllers or associated circuit boards. Volumes are based on historical overhead switchgear controller failure data.

8.11.2 Fault indicator replacements

In relation to fault indicators, TasNetworks' efforts to date have only been concerned with battery replacements. Based on an average age extending to the early 1990s, future work programs have been developed to replace these devices in their entirety to ensure a healthy working asset class over the next ten years.

Replacement programs have been developed for both ground-mounted and overhead fault indicators, with a small percentage of each planned to be equipped with remote communications for increased visibility and fault response capability.

8.12 Improve Reliability and Quality (CAPEX)

8.12.1 Install SCADA communications to Cooper regulators - PRCOO

This capital program involves retrofitting Cooper single-phase high voltage regulators with communications hardware to provide for remote monitoring and control.

The aim of this program is to reduce operational expenditure associated with,

a) manually operating the equipment under various contingencies; and
b) performing periodic load checks and other routine tests.

This program is split according to Northern, North Western and Southern areas.

The program has been developed in consultation with Distribution Operations to manage risk, with a focus on key feeders likely to be paralleled under fault conditions.

8.12.2 Ground-mounted voltage regulator SCADA upgrades

TasNetworks has a fleet of 33 ground-mounted voltage regulators and plans are to introduce SCADA communications (by installing new AVRs) to 13 of these sites over the forthcoming regulatory period. Sites will be chosen based on maximum operational benefit in consultation with key performance and operations staff.

8.13 Regulatory obligations

The lead regulatory obligations to be meet are National Electricity Rules clauses S5.1a.8, Fault clearance times and S5.1.9(c) Protection systems and fault clearance times. In addition to meeting these obligations protection and control is key to maintaining the performance to the Reliability Standards in the Tasmanian Electricity Code.

Key considerations in meeting the aforementioned are as follows.

8.13.1 Maintain network performance

Accurate discrimination of protection systems will isolate faulted areas, disconnect the minimum number of customers, and minimise impacts on reliability performance. The coordination between protection devices needs to be monitored and maintained as the network grows and develops over time.

Fast protection operation time will minimise asset damage and customer impacts from voltage dips due to reflected faults on the network.

8.13.2 Manage business operating risks at an appropriate level

SCADA and Automation Systems provide remote monitoring and control functionality to TasNetworks distribution primary and secondary assets. These systems ensure the safe diagnosis and operation of the primary and secondary equipment by allowing remote diagnostics and operation of equipment, reducing the need for operations staff to attend sites.

SCADA and Automation devices must have reliable operation to ensure they remain fit for purpose for their asset life.

8.14 Investment evaluation

Investment evaluation is undertaken using TasNetworks' Investment Evaluation Summary template. The template includes:

a) a brief description of the asset(s);
b) a description of the issues and investment drivers;
c) alignment with regulatory objectives;
d) alignment with TasNetworks' corporate objectives;
e) alignment with TasNetworks' corporate risks;
f) impacts to customers;
g) analysis of options to rectify the issues including operational and capital expenditures;
h) a summary of NPV economic analysis for the identified options;
i) the preferred option and why;
j) the timing of the investment; and
k) the expected outcomes and benefits.

8.15 Spares management

The management of spares is a joint strategic and operational responsibility across TasNetworks and is key in managing asset risk. Deficiencies in spares holdings are identified during the asset management plan development and where these models of protection relay are not obsolete, spares are ordered in alignment with TasNetworks' spares policy.

8.16 Disposal plan

The project staff dispose of distribution SCADA and Automation equipment that are removed from service as part of either a capital replacement project or an OPEX-based maintenance activity. Asset types, which are not obsolete, may be refurbished and retained for system spares, as identified by TasNetworks operational staff.

8.17 Summary of programs

Table 17 provides a summary of all of the programs described in this management plan under both:

a) the 15/16 Program of Work cycle; and
b) the current asset management plan review cycle.

Table 17 Summary of Distribution SCADA and Automation Programs

CAPEX / OPEX	Work Program Level	Project/Program Description	Category Code
OPEX	Operating costs other	Operating Costs for Modem Communications	PRCOM
OPEX	Non-routine maintenance	Recloser and LBS Maintenance	AROPC
OPEX	Non-routine maintenance	Asset Repair OH Protection Switchgear Maintenance	AROPC
OPEX	Non-routine maintenance	Fault Indicator Maintenance	AROPC
OPEX	Routine maintenance	Urban Zone Substation SCADA Maintenance	RMZPC
CAPEX	Reliability and quality maintained	Replace Recloser and or Control Box	RERPC
CAPEX	SCADA & Network Control	Install SCADA Communications to Ground	PRCOO

CAPEX / OPEX	Work Program Level	Project/Program Description	Category Code
		Regulators	
CAPEX	Reliability and quality maintained	Zone Substation AVR replacement Sandy Bay	REUPC
CAPEX	Reliability and quality maintained	Zone substation AVR replacement Derwent Park and Newtown	REUPC
CAPEX	SCADA & Network Control	Zone Substation HMI replacement Claremont	REUPC
CAPEX	SCADA & Network Control	Zone substation HMI Installation	REUPC
CAPEX	SCADA & Network Control	Security system upgrade at Zone substations	REUPC
CAPEX	Reliability and quality maintained	Hobart CBD Pilot Wire Project (test, repair or replace) existing pilot wires	REUPC
CAPEX	Reliability and quality maintained	Hobart CBD Communication Infrastructure project (optical communications)	REGAU
CAPEX	SCADA & Network Control	SCADA control for metal clad gas insulated pole switches	RERPC
CAPEX	Reliability and quality maintained	Replace Cybertec 3G modems with new technology prior to 3G turn off	REOPC

9 Program of Work

9.1 Program delivery

TasNetworks makes a concerted effort to prepare a considered deliverability strategy based on the planned operational and capital program of work for distribution network assets. A number of factors contribute to the successful delivery of the program of work. These factors are utilised as inputs to prioritise and optimise the program of work, to ensure sustainable and efficient delivery is maintained. This program prioritisation or optimisation can affect delivery of individual work programs, to favour delivery of other programs. Factors considered include:

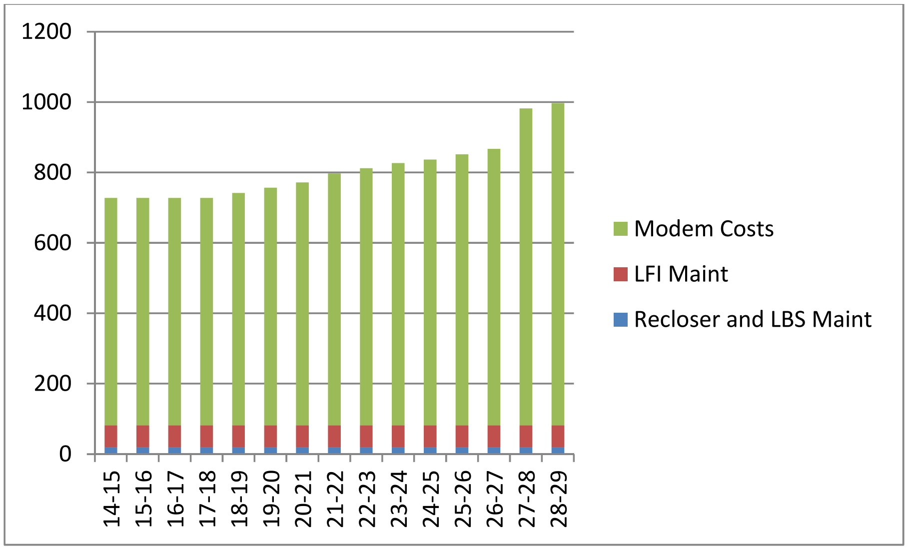
a) customer-driven work we must address under the National Electricity Customer Framework (NECF);
b) priority defects identified through inspection and routine maintenance activities;
c) identified asset risks as they relate to safety, the environment and the reliability of the electrical system;
d) adverse impacts of severe storms and bushfire events;
e) system outage constraints;
f) changes to individual project or program delivery strategy;
g) size and capability of its workforce;
h) support from external contract resources and supplementary service provision;
i) long lead equipment and materials issues;
j) resolution of specific technical and functional requirement issues;
k) complex design/construct projects with long lead times;
l) approvals, land acquisition or wayleaves; and
m) access issues.

Specific to the SCADA and Automation - Distribution asset management plan, these factors have resulted in the (essentially) successful delivery of the operational and delayed delivery of the capital programs of work.

9.2 Proposed OPEX plan

The operational programs and volumes of work identified in this management plan are necessary to manage operational and safety risks and maintain network reliably at an acceptable level. All operational work is prioritised based on current condition data, field failure rates and prudent risk management in accordance with TasNetworks' risk management framework. Figure 3 below shows the historical operational quantity and the proposed future quantity of work.

Figure 3 Total OPEX numbers, with forecast to 2028/29



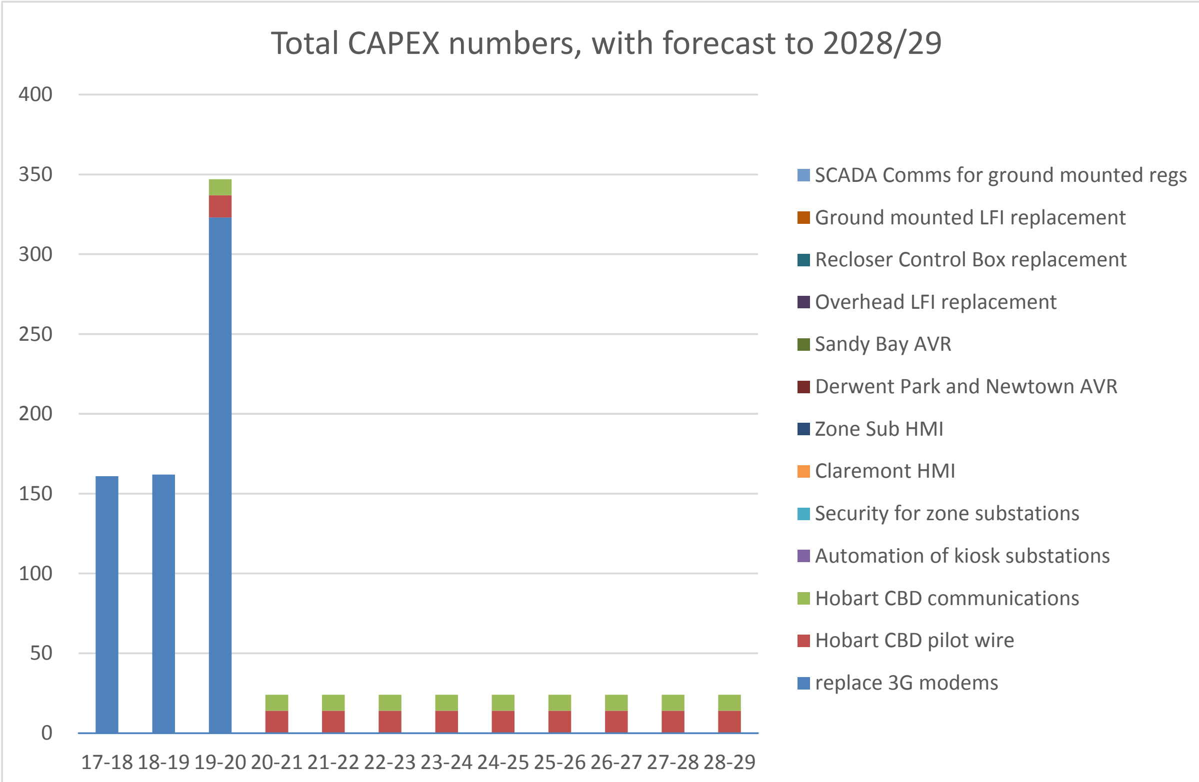
The increase in OPEX from 2018/19 to 2019/20 is attributable to:

a) the acceleration of a fault indicator restoration program under a previous leadership reliability strategy known as "Cause and Effect"; and
b) the increase of asset repair budgets to align with the increased number of HV switchgear being installed.

9.3 Proposed CAPEX plan

The capital programs and expenditure identified in this management plan are necessary to manage operational and safety risks and maintain network reliably at an acceptable level. All capital work is prioritised based on current condition data, field failure rates and prudent risk management in accordance with TasNetworks' risk management framework. Figure 4 below shows the historical operational quantity and the proposed future quantity of work.

Figure 4 Total CAPEX numbers, with forecast to 2028/29



The increase in CAPEX over the forthcoming regulatory period is attributable to the introduction of a number of key programs, which have been designed to manage TasNetworks' risk. These programs are discussed in the above sections.

A summary of the forecast for expenditure and volumes for the CAPEX and OPEX program of work can be located at the following link http://reclink/R0000789510.

9.4 Governance

TasNetworks purpose is to deliver electricity and telecommunications network services, creating value for our customers, our owners and our community.

TasNetworks Program of Work (POW) system is designed to integrate the program of works governance that certifies that the strategies identified in this plan are aligned to TasNetworks overall business strategies.

TasNetworks Asset Strategy and Performance team has established specific goals, quarterly measures and reports its progress towards meeting these goals, which are an integral part of TasNetworks business practices and are tracked along with other business objectives.

This document is owned by Asset Strategy and Performance and is reviewed every two and half years.

10 Related documents

The following documents either have been used to in the development of this asset management plan, or provide supporting information to it:

- R246439 SCADA System Standard
- Z-809-0085-SD-001/022 SCADA System Standard Panel Drawings
- TasNetworks Risk Management Framework
- D13/39576 Assessment of Proposed Regulatory Asset Lives
- R51737 System Spares Policy

Appendix A Summary of key programs and risk

Description	Work Category	Risk Level	Driver	Expenditure Type	Residual Risk	16/17 Volume	17/18 Volume	18/19 Volume	19/20 Volume	20/21 Volume	21/22 Volume	22/23 Volume	23/24 Volume
Operating Costs for Modem Communications	PRCOM	Med	Safety/ Reliability	OPEX	Low	646	646	660	675	679	715	745	755
Recloser & LBS Maintenance	AROPC	Low	Safety/ Reliability	OPEX	Low	20	20	20	20	20	20	20	20
Fault Indicator Maintenance	AROPC	Low	Safety/ Reliability	OPEX	Low	62	62	62	62	62	62	62	62
Urban Zone Substation SCADA Maintenance	RMZPC	Med	Safety/ Reliability	OPEX	Low	13	13	13	13	13	13	13	13
Replace Recloser & or Control Box	RERPC	Low	Safety/ Reliability	CAPEX	Low	6	6	6	6	6	6	6	6
Install SCADA Communications to Ground Regulators	PRCOO	Low	Safety/ Reliability	CAPEX	Low	2	2	2	2	2	2	2	2
Hobart CBD Pilot Wire Project	REOPC	Med	Safety/ Reliability	CAPEX	Low	0	0	0	14	14	14	14	14
Hobart CBD Communications Project (Fibre Optic)	REOPC	Med	Safety/ Reliability	CAPEX	Low	0	0	0	10	10	10	10	10
Replace 3G Modems	REOPC	Med	Safety/ Reliability	CAPEX	Low	0	161	161	323	0	0	0	0
Automation of kiosk substations		Med	Safety/ Reliability	CAPEX	Low	0	0	0	5	5	5	5	5
Security for zone substations		Med	Safety/ Reliability	CAPEX	Low	0	0	0	2	2	2	1	0
Claremont HMI		Med	Safety/ Reliability	CAPEX	Low	0	0	0	1	0	0	0	0
Zone Sub HMI		Med	Safety/ Reliability	CAPEX	Low	0	0	0	2	2	2	0	0
Derwent Park and Newtown AVR		Med	Safety/ Reliability	CAPEX	Low	4	0	0	0	0	0	0	0
Sandy Bay AVR		Med	Safety/ Reliability	CAPEX	Low	3	0	0	0	0	0	0	0
Overhead LFI replacement		Low	Safety/ Reliability	CAPEX	Low	23	23	23	23	23	23	23	23
Kiosk Substation Fault indicator		Low	Safety/ Reliability	CAPEX	Low	13	13	13	13	13	13	13	13