# AusNet Gas Services Pty Ltd

## Gas Access Arrangement Review 2018–2022

### Appendix 6I: Supervisory Control and Data Acquisition Strategy – Public

**Submitted: 16 December 2016**

# Supervisory Control and Data Acquisition Strategy

## Gas Network

# 2018 – 2022

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|---|---|
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# Executive Summary

This strategy document outlines the capital works programs and expenditure proposed for AusNet Services' Supervisory Control and Data Acquisition (SCADA) assets commencing in 2018 to 2022.

SCADA assets are used to remotely control and monitor equipment by operating over communication channels. AusNet Services' Customer and Energy Operations Team (CEOT) utilise the SCADA system to provide 24-hour visibility of the gas network via Remote Telemetry Units (RTU's). The CEOT can remotely control pressure values at various sites across the gas network, as well as monitor on site measures such as temperature, flow, explosive limits, water levels in pits, instrumentation status and other event data.

AusNet Services' four Gas Network Objectives underpin the Gas Access Arrangement Review proposal for 2018-22 and therefore drive the strategic capital programs proposed for the SCADA system. They are summarised below:

1. Maintain Network Safety in accordance with the Gas Safety Case;
2. Maintain top quartile operating efficiency;
3. Undertake prudent and sustainable network investment; and
4. Delivery of valued services to our customers.

The vision for AusNet Services' Gas SCADA network is to ensure the relevant stakeholders (such as CEOT and Network Planning) have adequate and relevant visibility over the gas network. It is also to ensure that personnel working on SCADA assets can continue to do so in a safe manner, whilst also maintaining current levels of technology serviceability.

**Table 1: Financial Year Capital Expenditure to 2022**

| Program | CY: | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| Fringe RTU Installation / Relocation | $ '000 | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Unit | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| End of Life Replacement | $ '000 | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Unit | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| Common Earthing Installation | $ '000 | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Unit | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| Slam Shut Indicator Installation | $ '000 | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Unit | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| Pressure Transmitter Installation | $ '000 | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Unit | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| Cabinet Circuit Breakers | $ '000 | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Unit | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| Improved Data Capture and Monitoring | $ '000 | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Unit | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **Total Expenditure ('000)** | | **378** | **330** | **299** | **300** | **358** | **1,664** |

# 1 Document Overview

## 1.1 Purpose

The Supervisory Control and Data Acquisition (SCADA) Strategy is one of several plant strategies developed and maintained for the management of AusNet Services' Gas Distribution Network. This document provides background on SCADA assets and describes the approach used to manage them.

## 1.2 Scope

SCADA systems are used to remotely control and monitor equipment by operating over communication channels. This SCADA strategy covers the equipment which supports the communication and control of data but not the communication system itself. The communication system is covered in *AMS 30-59 Communication Systems*.

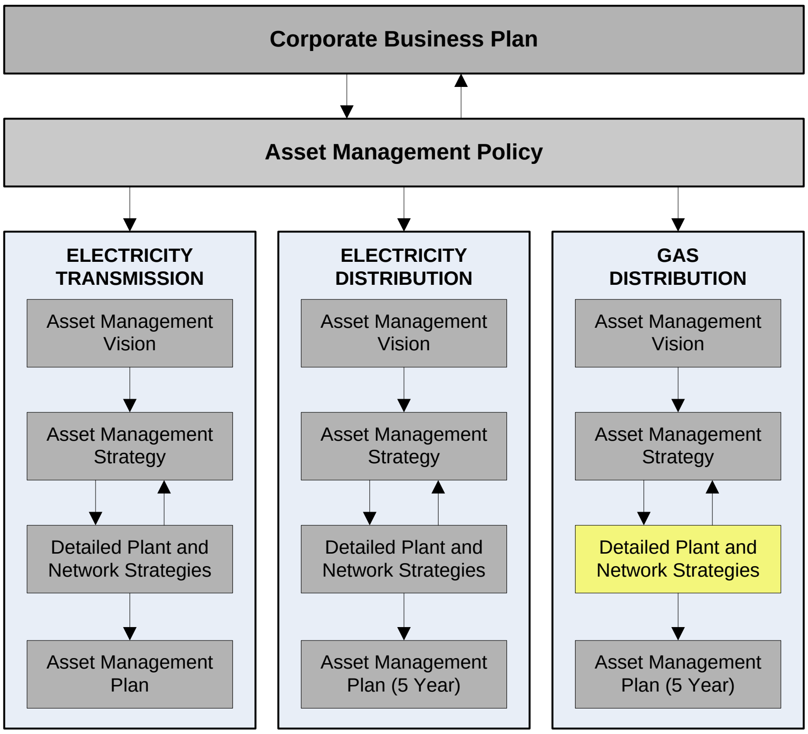
## 1.3 Definitions

| | |
|---|---|
| CEOT | Customer and Energy Operations Team |
| GaSPC | Gas System Pressure Control |
| IEC-EX | International Electro-technical Commission Explosive |
| OSI Pi | Pi Historian software program used for data trending |
| RCD | Residual Current Device |
| RCPR | Remote Cathodic Protection Recorder |
| RPR | Remote Pressure Recorder |
| RTU | Remote Telemetry Units |
| SCADA | Supervisory Control and Data Acquisition |
| SSB | Slam Shut B (leg) |
| SSP | Slam Shut Panel |

## 1.4 Relationship with Other Management Documents

This SCADA Strategy is one of a number of asset management related documents developed and published by AusNet Services in relation to its gas distribution and transmission networks. As indicated in the figure below, detailed plant strategies, in which the Gas SCADA Strategy belongs, informs both the Asset Management Strategy (AMS) and Asset Management Plan (AMP) of the required capital programs needed to achieve the long-term objectives of the gas distribution network.

**Figure 1: Asset Management System document interdependencies**




## 1.5 References

Other referenced documents within this strategy are:

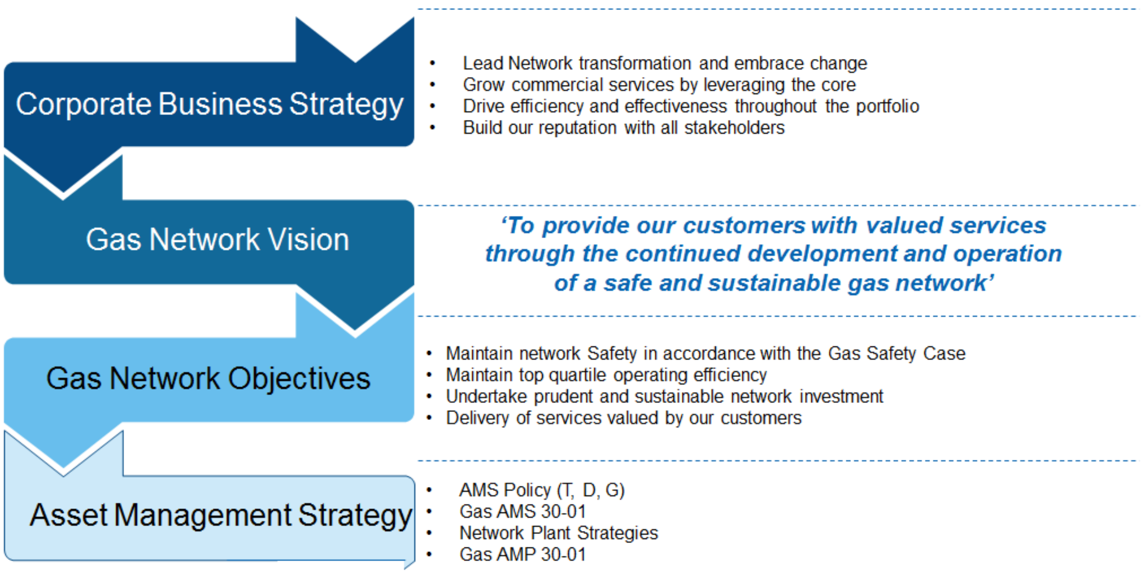
- AMS 30-01 Gas Asset Management Strategy
- AMS 30-59 Communications Systems Strategy
- Fringe RTU Location Report
- Gas Safety Act 1997
- Gas Distribution System Code (Version 10)
- Gas Safety Case
- TS4356 Metering Room

# 2 Alignment of AusNet Services' Business Drivers and Objectives

AusNet Services' purpose statement is to "Empower communities and their energy future." This statement places the customer (as individuals and communities) at the forefront as a business driver and acknowledges the critical relationship with their energy supply and usage, and is a key theme throughout the Corporate Business Strategy.

The following diagram provides the connection between AusNet Services' corporate strategy and the gas network vision, consistent with providing valued customer service and sustainable network investment. The gas network objectives, which stems network vision drives the development of the programs for each of the asset strategies.

**Figure 2: Alignment from AusNet Services' Corporate Strategy through to Asset Strategies**




The gas network objectives' alignment with the business, regulators, and the delivery of plant strategies are detailed below:

1. **Maintain Network Safety in accordance with the Gas Safety Case**

   Maintains the alignment to AusNet Services' commitment to 'Mission Zero'. The objective to maintain network safety is in recognition of AusNet Gas Services' current safety performance and design of the network.

2. **Maintain top quartile operating efficiency**

   Aligns to the Corporate Business Plan with AusNet Services' aspiration to operate "all three core networks in the top quartile of efficiency benchmarks".

3. **Undertake prudent and sustainable network investment**

   Alignment to AusNet Services' obligation to undertake prudent and sustainable network investment, as defined in the National Gas Rules and Gas Distribution System Code.

4. **Delivery of valued services to our customers**

   Establishes the need to better understand our customers (their needs and behaviours) and deliver services they value.

# 3 Asset Overview

## 3.1 Introduction

Supervisory Control and Data Acquisition (SCADA) systems are used to remotely control and monitor equipment by operating over communication channels. AusNet Services' Customer and Energy Operations Team (CEOT) utilise the SCADA system to provide 24-hour visibility of the gas network via Remote Telemetry Units (RTU's).

The SCADA system provides real-time data on the performance of assets, such as pressure, temperature, flow, etc. This data is used to monitor the network, as well as provide long-term trending information. This can be employed for long-term evaluation of gas demand and for network modelling to improve network capacity and system performance. SCADA is an integral tool for controllers and engineers, assisting in effective responses during emergencies and real-time operational management of the network.

The Gas SCADA network infrastructure can be separated into three main parts:

- Master Station – Controller interface at CEOT;
- Communications – Radio base station and communication protocols; and
- Remote Assets – Control, monitoring and auxiliary equipment on site.

## 3.2 Asset Description – Master Station

The SCADA master station polls the remote station data in real-time, interprets it and displays it to the operations personnel at the CEOT. Plant control is performed by the CEOT via the SCADA system which issues control commands to the remote station device. The SCADA system presents the information in schematic representation and overview diagrams. Operator attention is also drawn to alarms and events as well as critical issues derived from rule based calculations within the SCADA system

## 3.3 Asset Description – Communications

Communications assets are an integral part of the SCADA network and ensure that the gas network has the ability to transport data back to the master station.

The following types of communications assets are installed:

- Communications devices associated with remote gas devices (e.g. RTU's) Communications wireless base station infrastructure used for the purpose of communicating to remote field devices;
- Communications back-haul infrastructure for the purpose of backhauling data traffic from base stations to data centre(s).

For further detail, refer to *AMS 30-59 Communication Systems*.

## 3.4 Asset Description – Remote Systems

The SCADA system uses Remote Telemetry Units (RTUs) to monitor and/or control the operation of 100% of the gas Transmission and Distribution systems. SCADA provides information that is used to maximise the operational efficiency of the gas network and manage gas flows during routine and unplanned operations. There are four types of sites as listed below:

1. **Fringe RTU** sites send real-time data back through the SCADA interface and are used to monitor the pressure at the lowest pressure extremity of a network, allowing the control room operators to react to pre-determined alarm limits;

2. **Monitored** pressure regulating sites where the outlet pressures are adjusted by field personnel at the site and SCADA is used to alert the control room operators if pre-determined alarm limits (pressure, temperature, access) are breached. The controllers have the ability to only monitor the data points at these sites, not make any remote changes;
3. **Controlled** pressure regulating sites are sites where the pressure set-point of the regulator has the capability (via the SCADA system) to be altered and set remotely by the controller at the CEOT; and
4. **Fringe controlled** pressure regulating sites are sites where the SCADA system maintains a set fringe pressure by altering gas outlet pressure at the regulating station either automatically or via remote manual control from the control room.

**Disaster recovery/redundancy**

Regulating station pressure outlet is set on-site to a predetermined pressure (failsafe mode). This is activated if the RTU of that regulating station loses communication contact with the master station.

### 3.4.1 General SCADA Site Equipment

General SCADA site equipment covers other equipment that supports the overall operation of the SCADA network.

- RTU Cabinets
- Antennas
- Solar Panels
- Batteries
- Junction box
- Cable supports

**Figure 3: General SCADA Site equipment**

## 3.5 Asset Summary

The table below provides a summary of AusNet Services' Gas SCADA assets (as of June 2016).

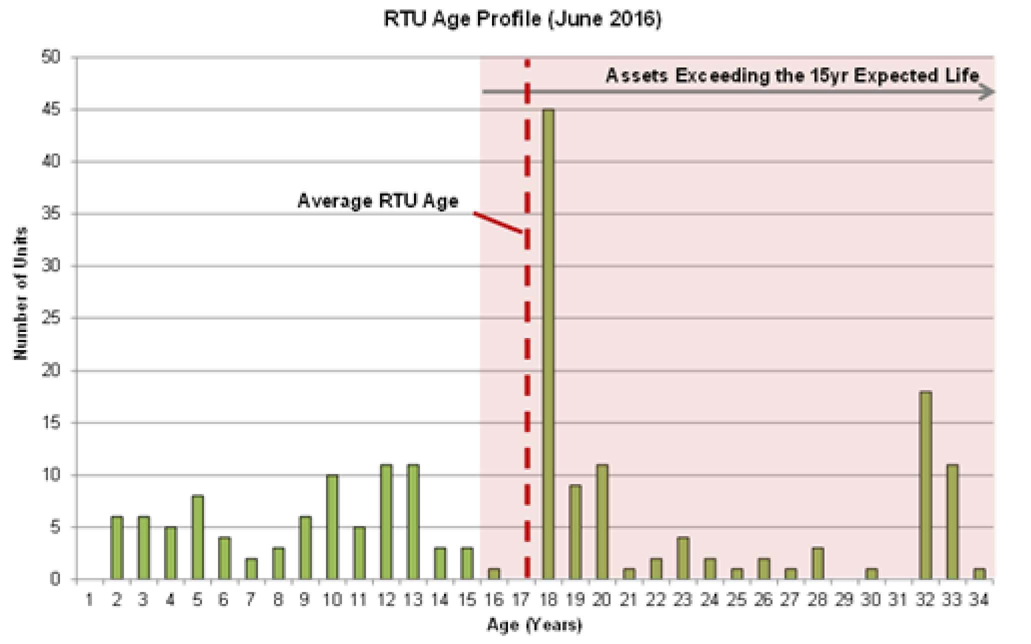
**Table 2: AusNet Services' SCADA Assets (as of June 2016)**

| | | | |
|---|---|---|---|
| **SCADA Assets** | Average age | | 17.4 years |
| | Number of RTU's | Fringe | 46 RTU's |
| | | Monitor | 85 RTU's |
| | | District Regulator | 6 RTU's |
| | | Controlled | 59 RTU's |
| | | **TOTAL** | **196 RTU's** |
| **SCADA Controlled Networks** | Controlled HP Networks | | 12 Networks |
| | Monitored HP Networks | | 15 Networks |
| | Monitored MP Networks | | All Networks |
| | Monitored LP Networks | | All Networks |
| **Communications Assets** | Number of Radio Base Stations | | 9 Sites |
| | Data / Control Centres | | 2 Sites |

## 3.6 Age Profile

The age profile of AusNet Services' SCADA RTU's within the gas network is shown in the figure below.

**Figure 4: RTU Age Profile**




The average age of RTU's installed in AusNet Services' gas network is 17 years, in comparison to an expected life of 15 years.

SCADA assets are not replaced as part of a planned schedule replacement based on expected life but rather are reactively replaced based on asset failure, asset obsolescence, certification expiration, and technological upgrades.

# 4 Risks

It is critical that SCADA system and communication equipment are relevant and compliant to ensure safe and accurate representation of the performance of the gas network. In particular it is critical to have equipment that provides reliable information in times when outage management is required or to model network performance.

Failure of SCADA equipment can result in catastrophic failure of gas equipment in the field. The CEOT would be unable to have visibility of current operating characteristics such as pressure, temperature, set points, etc. It would remove the ability of the CEOT to be both proactive before faults occur, and reactively troubleshoot once a fault has occurred. Constant visibility of data points at sites ensures that gas controllers can make informed decisions based on real-time data. It also mitigates the risk of public harm by ensuring that failure of high consequence equipment results in prompt CEOT and field response, and therefore rectification. Public harm will most likely be in the form of an explosion if equipment design limits are breached and not immediately identified.

Risk is also present due to the potential for lightning strike near to the facilities. Lightning strike can create a potential difference between items within a city gate. The presence of a potential difference within a city gate can lead to arcing, and in the presence of a gas leak can lead to an explosive environment.

An additional safety risk is the risk of electric shock to personnel working on equipment in SCADA cabinets that do not have residual current device protection.

# 5 SCADA Strategies

## 5.1 Fringe RTU Installation / Relocation

Fringe RTU's are installed at the outer boundary of networks to monitor pressure levels at the expected geographical point with the lowest pressure. These RTU's then utilise the communications network to send real-time pressure data back to the CEOT control room. The fringe pressure data points can be viewed via the Gas System Pressure Control (GaSPC) software program and used to make real-time decisions regarding pressure set points upstream of the fringe RTU to ensure that minimum obligated pressure levels are sustained. Data is also captured within the OSI Pi software application and utilised for trending and analysis purposes.

A program has largely been completed to enable pressure visibility at network extremities. Hence, the proposed program for this forthcoming regulatory period (2018-2022) is a significant decrease from previously.

An analysis of fringe pressure location identified the relocation of one existing fringe RTU due to organic growth of the network and the installation of 5 new fringe RTU's. Network modelling indicates that the existing RTU will require relocation once organic network growth is such that the RTU is no longer located at the true fringe of the network.

***Strategies:***

- ***Continue installation of fringe RTU's.***
- ***Relocate fringe RTU when it is no longer located on the fringe.***

Refer to Appendix 8.1 for site details of the proposed program.

## 5.2 End of Life Replacement

A number of equipment types installed on the SCADA network have been identified as requiring upgrade due to future serviceability and compliance.

### 5.2.1 Solar Array Replacement

**Background**

There are 17 sites on the network which are too remote to operate off a mains electricity supply. In these circumstances the sites are supplied by solar panels with backup batteries.

There are ten sites which are solar powered and have exceeded their effective life of 15 years. The majority of solar panels installed at these sites were installed in the early 1990's and, over time, the output of these arrays has deteriorated. Further, solar array technology has significantly improved in terms of efficiency and capacity. As the power requirements of sites increase over time (mostly due to equipment upgrades) this can cause capacity faults, especially during times of high network utilisation (i.e. winter).

Backup batteries also deteriorate over time and eventually will not hold sufficient charge to provide backup supply for the required duration. A number of backup batteries will reach the end-of-life during the forecast period and some auxiliary equipment such as backup batteries and battery boxes will need to be upgraded when solar panels are replaced.

**Figure 5: Solar Array at a City Gate**

***Strategies:***

- ***Replace solar arrays where the existing arrays no longer have sufficient capacity due to deterioration or increased demand.***
- ***Upgrade batteries and battery boxes in conjunction with solar array replacements.***

Refer to Appendix 8.2 for site details of the proposed program.

### 5.2.2 PC-1 Decommissioning

**Background**

To have the capability to send data back to the master station, a piece of equipment called a Central Processing Unit (CPU) module is installed in the SCADA RTU cabinet. A module called PC-1is utilised, manufactured by Kingfisher to send fault alarm data back to the master station at the CEOT.

In mid-2014, AusNet Services was made aware that by the end of 2015, Kingfisher would cease manufacture of the PC-1 module and replace it with a model called CP-12. The new model has the capability to have 16 alarm points (compared to the PC-1 which could only have up to 3). This would increase the capability of the controllers at the CEOT to troubleshoot alarms more effectively.

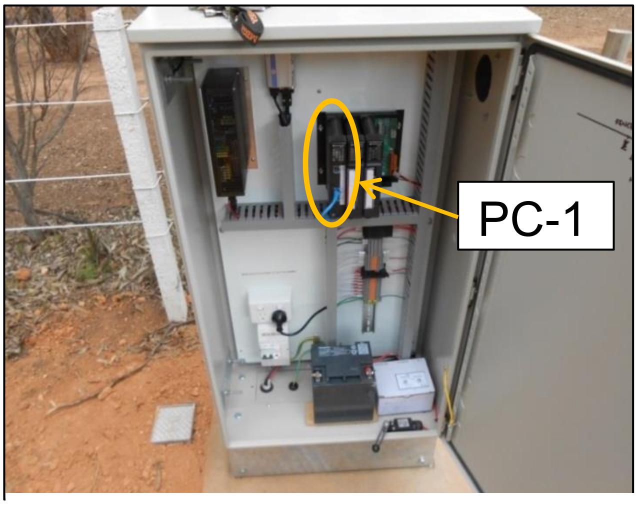



**Figure 6: SCADA Cabinet with PC-1**

Further, the existing backplane in the cabinet will not operate with the CP-12 and consequently any replacement of the CPU will necessitate replacement of the backplane.

Currently, there are 220 RTU's installed across the gas network and all have PC-1 modules. Based on current failure rates, it is proposed to proactively install small volumes of new CP-12's and utilise the removed PC-1's as strategic spares to be used to maintain the remaining PC-1s.

***Strategies:***

- ***Install new CP-12's and backplanes at a small number of sites across the gas SCADA network.***
- ***Utilise decommissioned PC-1s as spare parts to extend the life of sites fitted with PC-1s.***

See Appendix 0 for details of the proposed program of works.

### 5.2.3 Temperature Transmitter Replacement

**Background**

Temperature transmitters typically are installed at sites where gas network controllers require visibility of the temperature. For example, the outlet pipework of a city gate has a temperature transmitter to control temperature outlet of the heater, to avoid icing of pipework.

**Replacement**

A number of sites have been identified with aged temperature transmitters which can no longer effectively be kept in service or fail to comply with AS2381.1.[A] These temperature transmitters were manufactured by Rosemount 20-30 years ago and are no longer compliant with today's current IECEx[B] (electrical equipment for use in explosive atmospheres) standard.

All existing Rosemount-type temperature transmitters will be replaced by Yokogawa YTA110's. This has been identified as the most suitable replacement and has been installed at other newer sites on the SCADA network.

**Figure 7: Rosemount Temperature Transmitter**

***Strategy:***

- ***Remove non-compliant Rosemount temperature transmitters and install Yokogawa YTA110's.***

See Appendix 8.2.3 for a list of sites.

## 5.3 Common Earthing Installation

**Background**

All equipment, including fencing, is earthed to protect personnel and equipment from harm or damage in the event of a lightning strike.

Lightning damage to above-ground facilities or a hazard to personnel can arise in four ways:

1. Lightning strikes directly to the above-ground facilities;
2. Lightning strikes to ground near the facilities;
3. Lightning strikes to ground near the pipeline; and,
4. Lightning strikes to incoming electricity supply or telecommunications conductors.

Installation of a common earth grid dissipates most of the charge and ensures that there is no potential difference between different equipment within a city gate compound. The presence of a potential difference within a city gate can lead to arcing, and in the presence of a gas leak can lead to an explosive environment.

A number of city gate sites have been identified as having equipment not connected to a common earthing grid. The equipment is individually earthed, but not connected to a common earth grid. Installing a common earth grid

[A] AS2381 – Electrical Equipment for Explosive Gas Atmospheres.

[B] IECEx – International Electrotechnical Commission system for certification to standards relating to equipment for use in Explosive atmospheres.

would ensure that all sites are properly earthed to protect personnel and equipment from harm or damage in the event of lightning strike.

As the fencing of city gate sites is progressively upgraded, it is becoming increasingly important that all sites are adequately earthed to mitigate the risk of personnel injury and/or explosion.

***Strategy:***

- ***Install a common earth grid at identified city gate sites.***

See Appendix 8.3 for a list of sites.

## 5.4 Slam Shut B Indicator Installation

**Background**

Slam Shut Panels (SSP) are used on pressure regulating stations to protect the downstream pipe work against over pressurisation. Over pressurisation of downstream assets such as gas distribution pipes and customer metering facilities increases the risk of mechanical failure as these assets operate above design limits. This can result in a gas explosion, thus posing a high risk to the public.

The SSP controls pneumatic actuators which are mounted on valves in A and B legs. The purpose of this device is to shut down a faulty run of regulators, or in the unlikely event of failure of both runs, to control within safe limits the outlet pressure of a station.

Slam shut switches monitor changes in the position of the slam shut valves from open to close and relays this information back to the control room. This provides timely detection of any over pressurisation issues that may have triggered slam shut and are critical pieces of infrastructure.

Five sites have no Slam Shut B (SSB) Indicators installed. This program would install SSB indicators on the remaining five sites.

***Scope:***

- ***Install SSB indicators to sites where required.***

See Appendix 8.4 for a list of the sites.

## 5.5 Residual Current Device Installation

There are SCADA RTU cabinets which have circuit breakers installed and require Residual Current Device (RCD) protection.

Without RCD protection, personnel working on equipment inside SCADA cabinets installed from are susceptible to electric shocks. The program will target cabinets installed that are absent of RCD protection.

***Strategy:***

- ***Install RCD protected circuit breakers at required sites.***

See Appendix 8.6 for a list of individual sites.

## 5.6 Pressure Transmitter Installation

AusNet Services supplies some high demand customers directly off the transmission network. These metering installations are subject to 6-monthly maintenance checks and are treated as a higher-risk asset than a metering installation supplied off the distribution network. The consequence of mechanical failure at a transmission metering installation is higher than that of a distribution metering installation due to the increased volume of gas released.

These installations usually have two regulators installed for redundancy reasons; if one regulator fails the second one takes over. If the second regulator then fails before the next 6-monthly check, there is the potential for downstream pipework to see transmission pressures. This can result in a gas explosion, thus posing a high risk to the public and customers' downstream assets.

This program would install a pressure transmitter linked to an alarm at customers' metering installations supplied directly from transmission pressure. When pressures downstream of the regulators are too high, the alarm would trigger the CEOT to send a gas fitter out immediately to respond to the issue.

***Strategy:***

- ***Install alarmed pressure transmitters at required sites.***

See Appendix 0 for a list of the sites.

## 5.7 Improved Pressure Data Capture and Monitoring

### 5.7.1 Remote Pressure Loggers

**Current Winter Testing Chart Recorders**

As part of the annual Winter Testing Program, the maintenance service provider installs chart recorders at networks and residential location points selected by the Network Planning group. These charts are collated at the end of a 2-week chart run and sent back to the Gas Network Planning team for analysis. This service costs approximately $C-I-C p.a.

Reliable data from Winter Testing is important as it is the key source for defining the annual augmentation program. The current process yields inaccuracies due to data quality and readability of some returned charts are at a low level, forcing best-fit estimates to be made in the case of unusable data (see figure on the right).

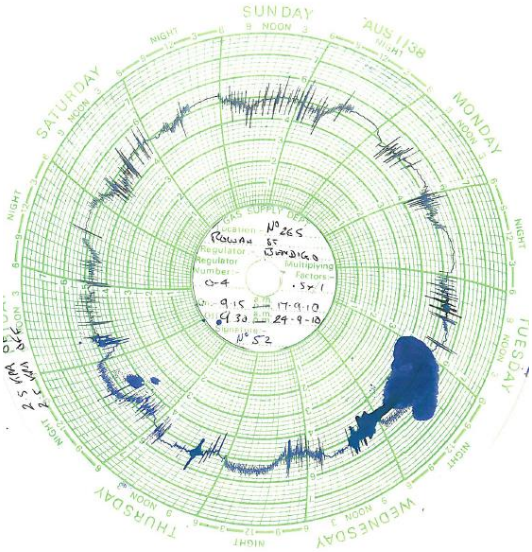



**Figure 8: Poor data from winter testing chart**

Network Planning has identified the replacement of chart recorders as a crucial step in achieving more accurate network models for Winter Testing and Analysis. This ensures that prudent and sustainable investment in the delivery of the augmentation program.

**Background**

In order to improve the data from Winter Testing, approximately 35 digital pressure loggers were purchased and trialled within the gas networks utilising GPRS (2G) telecommunications network to send data back once a day. Telstra has since advised that they planned to close down the GPRS (2G) network by the end of 2016 due to low utilisation. These digital pressure loggers improved the data recorded during Winter Testing but they are now obsolete

A trial of a new digital recorder which operates in a stand-alone mode has been completed. Operation of the device in stand-alone mode means that data recording is not constrained by the operation of the communication network. Further, the recorders are fully IECEx[C] rated and applicable for use in areas classified as hazardous. A significant advantage of these recorders is that they are more accurate and portable than a chart recorder.

***Strategy:***

- ***Progressively roll-out stand-alone digital pressure recorders.***

[C] IECEx certification ensures equipment compliance with hazardous area use standards and is intrinsically safe.

# 6 Alignment with Network Objectives

This section provides an overview of the alignment of the programs proposed in the SCADA Strategy with the gas network objectives which govern how the network is operated and maintained.

See Section 2 for detail on AusNet Services' gas network objectives.

**Table 3: Alignment of SCADA Strategies with Gas Network Objectives**

| SCADA Programs | Gas Network Objective | | | |
|---|---|---|---|---|
| | Maintain network Safety | Maintain operating efficiency | Undertake prudent & sustainable investment | Deliver valued services to customers |
| Fringe RTU Installation / Relocation | • | • | • | • |
| End of Life Replacement | • | | • | |
| Common Earthing Installation | • | | • | |
| Slam Shut Indicator Installation | • | | • | • |
| Pressure Transmitter Installation | • | | | • |
| Cabinet Circuit Breaker Installation | • | | • | |
| Improved pressure data capture and maintenance | • | • | • | • |

| Gas Network Objectives |
|---|
| *Maintain network safety in accordance with the Gas Safety Case;*<br>• The proactive replacement of end of life of equipment reduces the possibility of asset failure, reducing the risk from a potentially unsafe environment.<br>• The implementation of safety related programs (common earthing, Slam Shut B Switch indicators, and cabinet circuit breakers) prevent injury of personnel working on site, and minimises the risk of downstream failure.<br>• The installation of pressure transmitters at transmission pressure metering installations mitigates the risk of downstream pipework seeing pressures above their design limit. This minimises publisc harm as a result of a gas explosion.<br>*Maintain top quartile operating efficiency;*<br>• Installing remote pressure loggers and RTU sites ensures that decisions regarding network reinforcement are being made with accurate data.<br>*Undertake prudent and sustainable network investment;*<br>• Installation of fringe RTU's allows long term trending analysis to be performed which assists in determining the appropriate timing of network reinforcements.<br>• End of life replacement eliminates assets that are expensive and difficult to maintain.<br>• The implementation of safety related programs are considered prudent investment to the network.<br>*Deliver valued services to customers;*<br>• Installation of fringe RTU's gives visibility at network extremities and allows the controller to detect and act to avoid excessive pressure drops, which can impact on supply reliability to the customer.<br>• Installation of Slam Shut B indicator switches enable controllers to detect and rectify a situation where slam shut has occurred to avoid network pressure drops that can disrupt customer gas supply. |

# 7 Detailed Capital Expenditure Requirements

## 7.1 Phasing and Financial Disclosure

All programs are defined in financial years, aligning to AusNet Services' annual capital period between 1 April and 31 March in the following year.

All financial figures quoted within this document, including all historic and forecasted expenditure - unless otherwise specifically stated – have the following characteristics:

- Real Expenditure / Cost (reference year = 2016);
- Direct Expenditure only (i.e. excludes overheads and corporate finance costs); and
- In units of $1,000 (i.e. '000).

## 7.2 Summary of Programs

**Works Program**

**Table 4: Fringe RTU Works Program**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| Fringe RTU Installation / Relocation | New Fringe RTU ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | RTU relocation ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

**Works Program**

**Table 5: Solar Array Replacement Works Program**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| End of Life Replacement | Solar array replacement ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Solar Battery Backup ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | Battery Box ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

For additional details of proposed sites, see Appendix 8.2

**Works Program**

**Table 6: PC-1 Decommissioning Works Program**

| Strategy Category | Program | 2018 | 2019 | 2020* | 2021* | 2022* | Total |
|---|---|---|---|---|---|---|---|
| End of Life Replacement | PC-1 Decommissioning ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

* 2020 – 2022 includes sites which require additional works to utilise the capability of the equipment.

**Works Program**

**Table 7: Temperature Transmitter Works Program**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| End of Life Replacement | Temperature Transmitter replacement ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

**Works Program**

**Table 8: Common Earth Installation Works Program**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| Common Earthing Installation | Common Earth ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

**Works Program**

**Table 9: Slam Shut B Indicator Installation Program**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| **Slam Shut Indicator Installation** | Slam Shut Indicator Installation ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

**Works Program**

**Table 10: Pressure Transmitter Installation**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| **Pressure Transmitter Installation** | Pressure Indicator Installation ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

**Works Program**

**Table 11: Cabinet Circuit Breakers Installation**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| **Cabinet Circuit Breakers** | Cabinet Circuit Breakers Installation ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL EXPENDITURE ($'000)** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | **TOTAL UNITS** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

**Works Program**

**Table 12: Innovation Works Program**

| Strategy Category | Program | 2018 | 2019 | 2020 | 2021 | 2022 | Total |
|---|---|---|---|---|---|---|---|
| **Innovation** | Gas loggers ($'000) | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | UNITS | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

# 8 Appendix

## 8.1 Fringe RTU Installation / Relocation

| Year | Network | Suburb | Location | Type | Cost Estimate ($'000) |
|---|---|---|---|---|---|
| **2018** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2019** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2020** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2021** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2022** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

## 8.2 End of Life Replacement

### 8.2.1 Solar Array Program

| Year | Site Number | Installation Year | City Gate Location | New Solar Array | New Battery | Battery Box | Cost Estimate ($'000) |
|---|---|---|---|---|---|---|---|
| **2018** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2019** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2020** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2021** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2022** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

### 8.2.2 PC-1 Decommissioning

| Year | Site | Regulator Number | Name | Suburb | Cost Estimate ($'000) |
|---|---|---|---|---|---|
| **2018** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2019** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2020** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2021** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| **2022** | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |
| | C-I-C | C-I-C | C-I-C | C-I-C | C-I-C |

### 8.2.3 Temperature Transmitter Replacement

C-I-C

## 8.3 Common Earthing Installation

C-I-C

## 8.4 List of sites for Slam Shut B Indicator Program

C-I-C

## 8.5 Pressure Transmitter Installation

| |
|---|
| C-I-C |

## 8.6 Residual Current Device Installation

C-I-C