AusNet Gas Services Pty Ltd

Gas Access Arrangement Review 2018–2022

Appendix 6D: Network Regulator Strategy – Public

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Network Regulator Strategy

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Disclaimer

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Executive Summary

This document outlines the strategy between financial years 2018 and 2023 for all of AusNet Services' network pressure reduction facilities including City Gates, Field Regulators and District Regulators. In addition, gas heaters are covered within this strategy. These assets perform a critical function in delivering gas from the principal transmission pipelines and reducing the pressure to safely distribute gas to end users.

Various risks associated with the failure of these particular assets include:

- The occurrence of a fire or explosion within the facility. This creates a threat to the safety of the communities within the vicinity of the installation.
- Loss of supply through the facility resulting in customer outages.
- Loss of pressure control through the pressure regulating station which can result in the over pressurisation of downstream assets. This can cause damage to AusNet Services' assets and the possibility of loss of containment.
- The safety of the AusNet Services' maintenance personnel who are required to work on these sites.

AusNet Services must control these risks in order to maintain compliance with the various codes and acts including; The Gas Safety Act, The Pipelines Act, The Gas Distribution Code and AusNet Services' Gas Safety Case. Further to this AusNet Services has 4 key network objectives to which the gas network is operated to, these objectives are:

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

To meet these network objectives and maintain compliance with the relevant codes and acts, four capital works programs have been developed to be undertaken between 2018 and 2023. These programs include the replacement of critical components within certain pressure reduction stations to maintain the sites safety and reliability, the installation of gas heaters at certain sites to maintain compliance with various codes and maintain the reliability of supply through the site as well as other programs aimed at maintaining site security and safety of maintenance personnel. A summary of the capital expenditure required to support these programs can be seen below in Table 1.

A review of the operational maintenance plan for these assets has also taken place and the detail outlined in this document. It has been concluded that the current maintenance plan is adequate and shall not be changed.

Table 1: Financial Year Capital Expenditure to 2022

Program	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Welker Jet Regulator Upgrade	$400	$400	$350	-	-	-
Grove Regulator Replacement	$390	$390	$390	$1,050	$850	$780
Heater Replacement – Reliability	C-I-C	C-I-C	C-I-C	-	-	-
Heater Replacement – Change in Risk	C-I-C	C-I-C	-	-	-	-

Program	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Heater Replacement – New Installations	C-I-C	-	-	-	-	-
City Gate Lighting Installation Program	C-I-C	-	-	-	-	-
TOTAL Expenditure (‘000)	**$1,680**	**$1,970**	**$1,240**	**$1,050**	**$850**	**$780**

1. Document Overview

1.1 Purpose

The Network Regulator Strategy is one of several plant strategies developed and maintained for the management of AusNet Services' Gas Distribution Network. This document provides background on Network Regulators and heaters and describes the approach used to manage the assets.

1.2 Definitions

Joule-Thompson Effect – A phenomenon which describes the temperature change of the gas which occurs when the pressure is reduced through a pressure regulator. For ease of design, AusNet Services assumes a constant temperature drop of 5.6°C per 1000kPa pressure drop.

Kilopascal (kPa) – Standard unit of measure for pressure.

Medium Pressure (MP) – Pipeline operating pressures ranging from 15kPa to 210kPa.

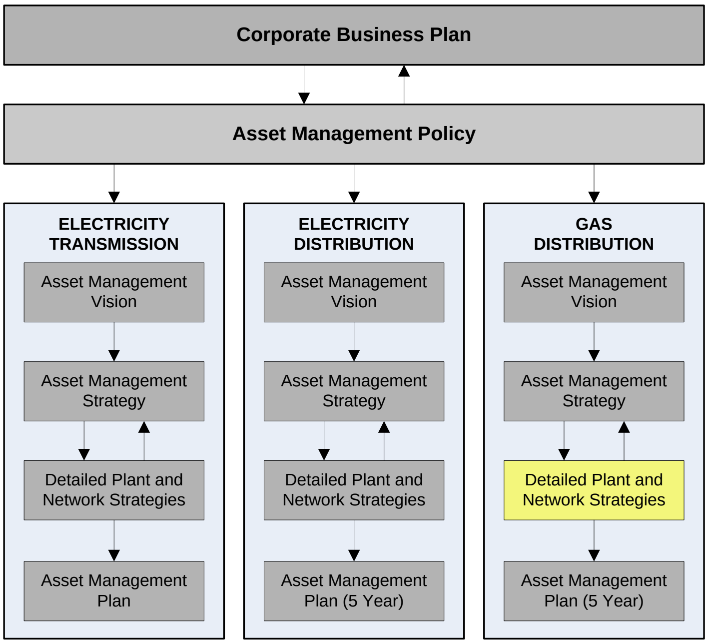
Principle Transmission Pipeline/System – Refers to the gas transmission pipeline system owned and operated state wide by APA.

Transmission System – Any pipeline system operating at a pressure in excess of 1050kPa and is designed in accordance with AS 2885.1.

1.3 Relationship with Other Management Documents

The Network Regulator Strategy is but one of a number of asset management related documents developed and published by AusNet Services in relation to its gas distribution network. As indicated in the figure below, detailed plant strategies, in which the Network Regulator 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

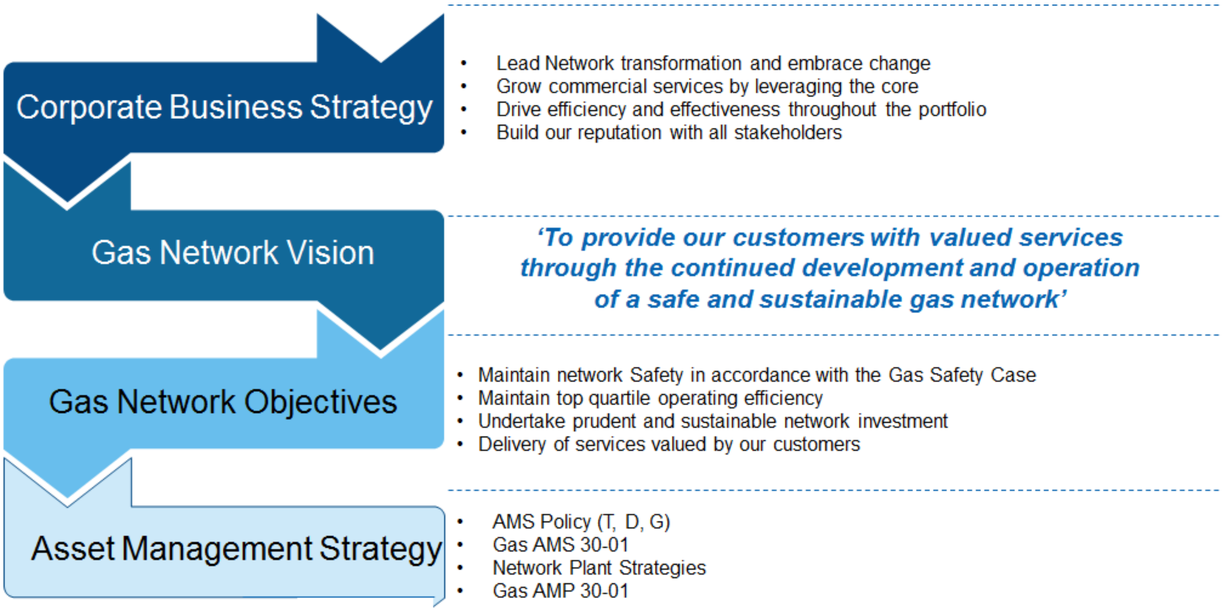


1.4 References

- Gas Safety Act 1997
- Gas Distribution System Code, Version 9
- AEMO Gas Quality Guidelines
- SP AusNet Gas Safety Case – Summary (GSC 10-00)
- Gas System Contingency Plan – (AMP 30-05)
- AS 2885.1-2012 Pipelines – Gas and Liquid Petroleum
- AS 4645 -2005 Gas Distribution Network Management
- AS 4041-2006 Pressure Piping

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 linkage 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.



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.

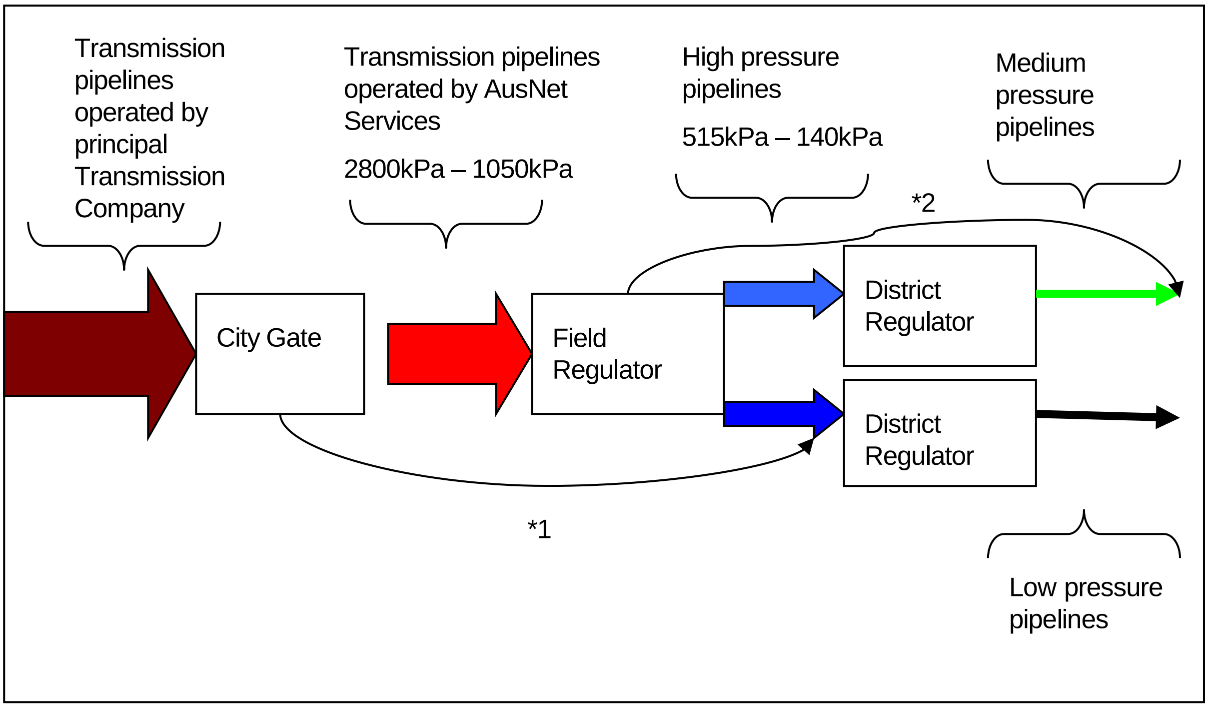
   Establishes the need to better understand our customers (their needs and behaviours) and deliver services they value.

3. Asset Overview

3.1 Introduction

The Network Regulator Strategy encompasses three classes of regulator facilities designed to deliver gas from the principle transmission system and safely distribute to AusNet Services' customers. Each class of regulator facility is assigned by the pressure it operates at, as indicated by the diagram below.

Figure 2: Schematic of regulator station asset classes



**There are instances where *1. City Gates take gas directly from the principle transmission pipeline and inject into high pressure distribution network and *2. Field Regulators take gas directly from AusNet Services' transmission pipelines and inject into the medium pressure distribution network.*

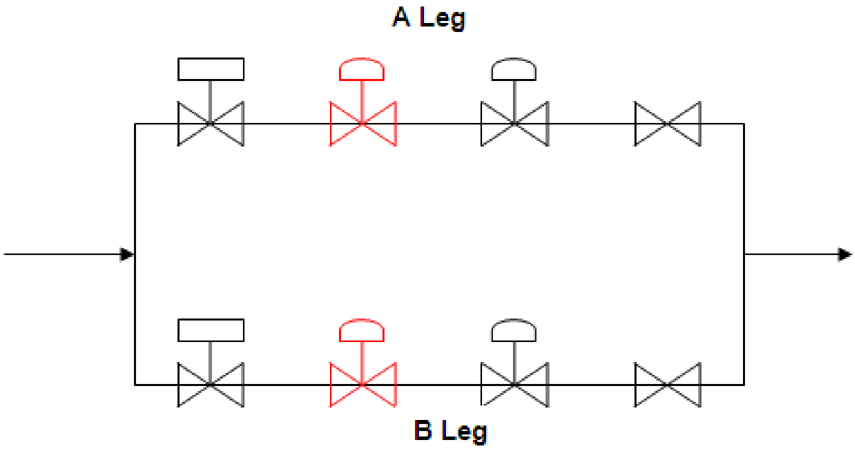
A summary of AusNet Services' Gas Network Regulating facilities is shown in Table 2 below.

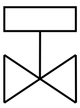
Table 2: Regulator (Network) Asset Base

Asset	Number / Length (1/07/2016)	Mean Service Life (Average Years)	Expected Service Life
City Gates	38 units	30 years	50 years
Field Regulators	106 units	31 years	50 years
District Regulators	73 units	26 years	50 years

The general arrangement of a City Gate, Field Regulator and District Regulator including the critical components in the pressure reduction process is depicted below. All pressure regulating stations have an A and B leg, for non SCADA remote controlled stations only one leg is operational at any time with the second leg being redundant but ready to take over supply should a failure occur on the working leg.

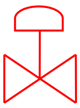
Figure 3: Schematic of pressure reduction station





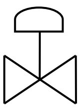
Slam Shut Valve

Automatically shuts off supply through the station when high outlet pressure is detected downstream.



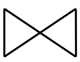
Monitor Regulator

Redundant regulator which takes over pressure reduction control in case of primary regulator failure.



Primary Regulator

The working regulator which is responsible for the pressure reduction process.



Isolation Valve

Manually operated valve which allows supply through the station to be isolated. Generally only utilised to allow maintenance to be performed on the station.

3.1.1 City Gates

City Gates have 3 levels of over pressure protection.

As the city gate marks the change in ownership of the gas pipelines, a custody transfer meter (CTM) is located on the city gate site. This meter measures the quantity of gas being injected into AusNet Services' gas network. In most cases the CTM is owned and operated by the principal transmission pipeline company.

3.1.2 Field Regulators

Field regulators have 3 levels of over pressure protection.

98 of the 106 Field Regulators are situated in underground pits. This allows field regulator installations to be located in densely populated areas as the underground pit requires less land space and poses a lower risk to the community should a major incident occur at the site. Some field regulator sites are located above ground either in a kiosk or in open space.

3.1.3 District Regulators

District Regulators only have 2 levels of over pressure protection. District regulators do not have Slam Shut valves as the third level of protection.

46 of the 73 District Regulators are located in underground pits with the remainder situated above ground.

3.1.4 Heaters

There are currently 36 gas heaters in operation at various city gates sites. The majority of these heaters are either gas fired water bath heaters or heat exchangers utilising a gas fired boiler and there is one electric heater in operation.

Gas heaters are installed at city gate sites to pre heat the gas prior to the pressure reduction process. During the pressure reduction process the temperature of the gas reduces, this is known as the Joule-Thompson Effect. The temperature drop at city gate sites quite often results in gas temperatures below 0°C at the outlet of the pressure regulators.

3.1.5 Coalescers

There are currently six coalescer units in operation. A coalescer is designed to extract liquids from the gas stream. The liquids in the gas stream are generally of the form of an oil substance which can be generated from hydrocarbon drop out or from lubricating oil utilised in the gas compressor stations. Liquids in the gas stream is undesirable as it can cause damage to assets including regulators and meters, the liquids can also cause major damage to customers appliances.

To mitigate the risk of liquids in the gas stream, colaescers were installed at strategic locations where liquid related issues were most predominant. This program took place in 2005/2006 and saw coalescers installed at the following locations:

- Selkirk Bricks – Ballarat
- McCains Foods – Ballarat
- Godfrey Hurst – Geelong
- Koroit City Gate – Koroit

In addition to this, a “Sample Coalescer” was developed. This unit was used to test for liquids entering particular gas networks. From this sampling investigation it was determined that the liquids issue was spasmodic. This being the case, rather than installing coalescers at all major city gates, AusNet Services developed 2 “Portable Coalescers”. The coalescers include a Class 600 unit capable of being installed upstream of City Gate pressure reduction stations and a smaller Class 150 unit which can be installed anywhere in the distribution network. These portable coalescers are mounted on a skid and are able to be transported on a flatbed truck to sites where liquids are identified to be an issue.

Given the recent report of liquids extracted from AusNet Services’ gas network, the strategy outlined above appears to have adequately mitigated this risk. Given this outcome the strategy of deploying the portable coalescers where required will be continued.

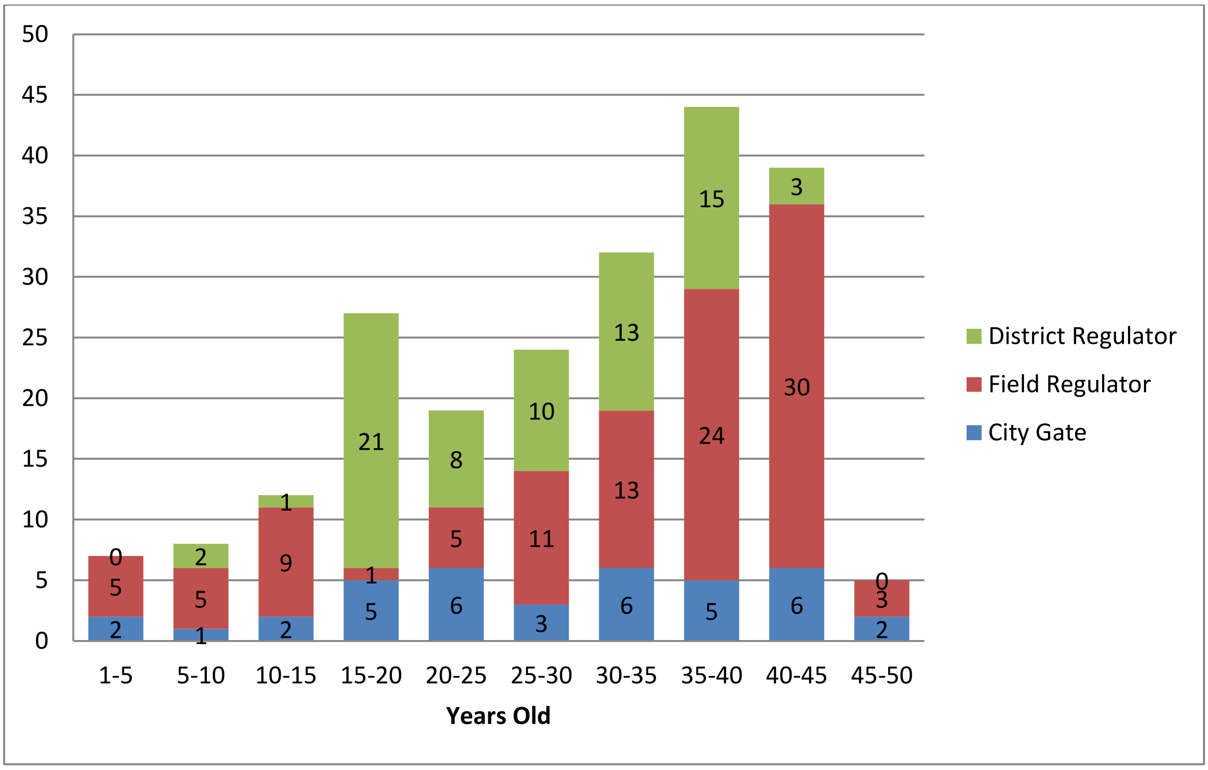
3.2 Age Profile

The age profile of the pressure regulating stations is identified in the chart below. AusNet Services' oldest installations are now 47 years old. New regulator facilities are currently being constructed to meet the growth in demand for gas and ensure gas pressures are maintained in accordance with the Gas Distribution Code, version 9, Schedule 1, Part A.

The design life of City Gate, Field Regulator, and District Regulator assets is 50 years. With an average network age of approximately 30 years the regulators are approaching there expected life. Within recent years, some of the regulators types including grove and Welker Jet/Jet Stream types have reliability issues, and have required replacement before they have seen their expected life.

The chart below depicts the age profile of AusNet Services' regulating facilities.

Figure 4: Age profile of Gas Regulator Facilities



3.2.1 City Gates

AusNet Services owns and operates 38 City Gate stations. The critical component within the city gate station is the pressure regulator valves. The pressure regulator valves are the instruments responsible for reducing the pressure and maintaining a constant outlet pressure. Failure of these instruments can cause the over pressurisation of the downstream assets. The city gate stations are classified by the type of regulators installed as each type of regulator operates differently and is subject to different operating issues. A summary of the different regulator families can be found below.

Table 3: City Gate Regulator Types

Regulator Type	Number of City Gate Sites	Age Profile (Install Year)
Welker Jet / Jet Stream	11	1971-2001
Grove	3	1973-1987
Axial Flow	15	1990-2015
Gorter	7	2006-2016
Apperflux	2	2014-2016

The ongoing extension of the gas network to accommodate the strong residential growth in Western Victoria, results in the construction of new city gates as well as upgrading the capacity of existing city gates.

Field Regulators

There are 106 field regulators in operation. As per the city gates, the field regulators are also classified by the type of regulator utilised at the site. Table 4 indicates a summary of the different types of regulators and their age profile.

Table 4: Field Regulator, Regulator Types

Regulator Type	Number of Field Regulator Sites	Age Profile (Install Year)
Jet Stream	2	1971-2001
Grove	36	1969-1995
Fisher	3	1979-1988
Axial Flow	63	1990-2015
RMG 850	1	2014-2015

The volume of field regulators is growing as new field regulators are installed to meet the growth in demand for residential gas connections.

District Regulators

AusNet Services' gas network currently consists of 73 District Regulators. As part of the mains renewal program, the low pressure district regulators are being decommissioned. Due to the mains renewal program the demand for gas through the district regulators is steadily declining. Due to this declining demand, there is little requirement for investment in district regulators other than maintaining the sites safety and reliability.

Heaters

AusNet Services currently has 36 heaters installed at various city gate sites throughout the network. A heater is required at every city gate site due to the large temperature drop caused by the pressure reduction process. There are three different types of heaters to provide the heating requirements at city gate sites:

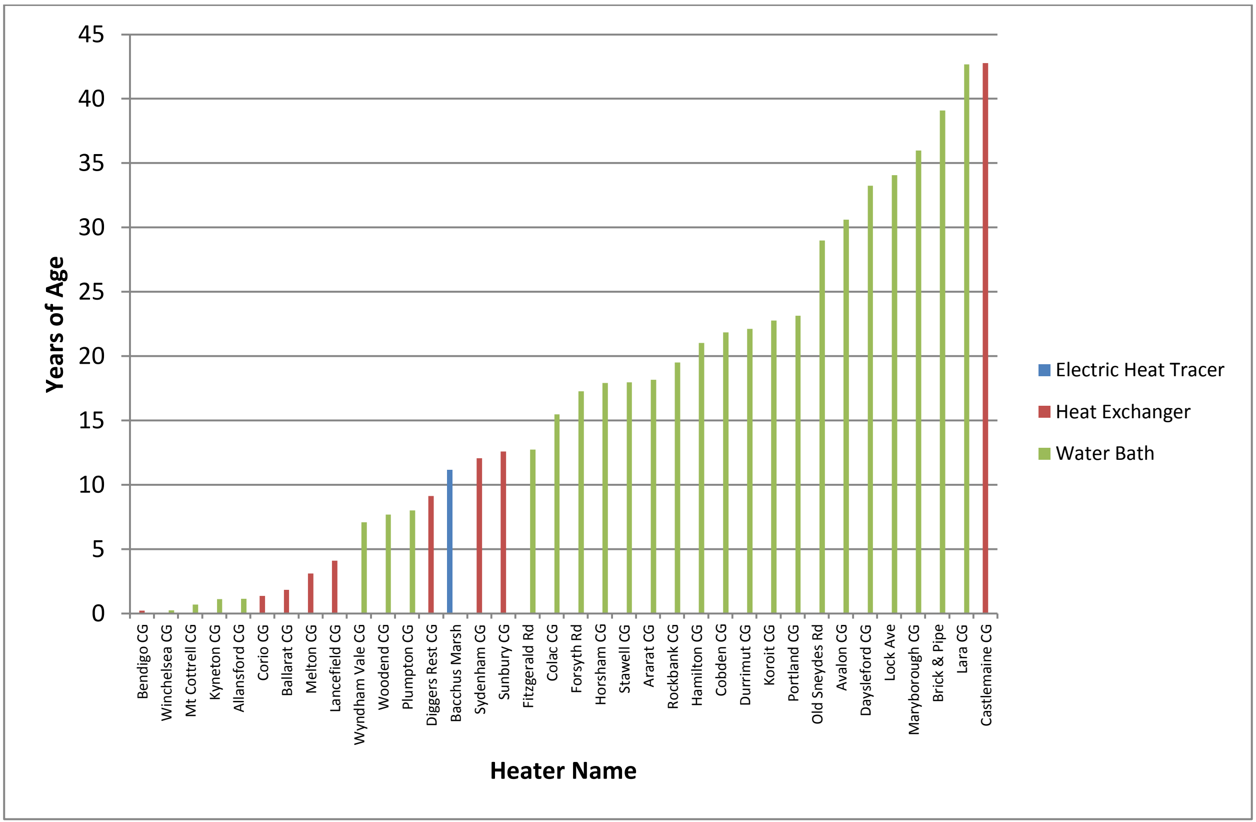
Water Bath Heater – These are the most widely used types of heaters with 26 installed across the network. This type of heater utilises a gas burner to maintain the temperature of a large vessel of water. A gas pipe is then coiled through the water bath to allow the heat transfer process to take place. The water bath heater has been utilised at some of AusNet Services' older city gate sites and are still being installed in new city gate sites.

Heat Exchanger – These types of heater utilise a gas boiler to heat water which is circulated by an electric pump through a heat exchanger where the heat is transferred into the gas stream.

Electric Heat Tracer Element – This system consists of electric heat elements wrapped around the external surface of the above ground pipe work to transfer heat into the gas stream. This system is installed at Bacchus Marsh City Gate but is scheduled to be replaced as outlined in Section 5.

The chart below indicates the age and heater type installed and each city gate site.

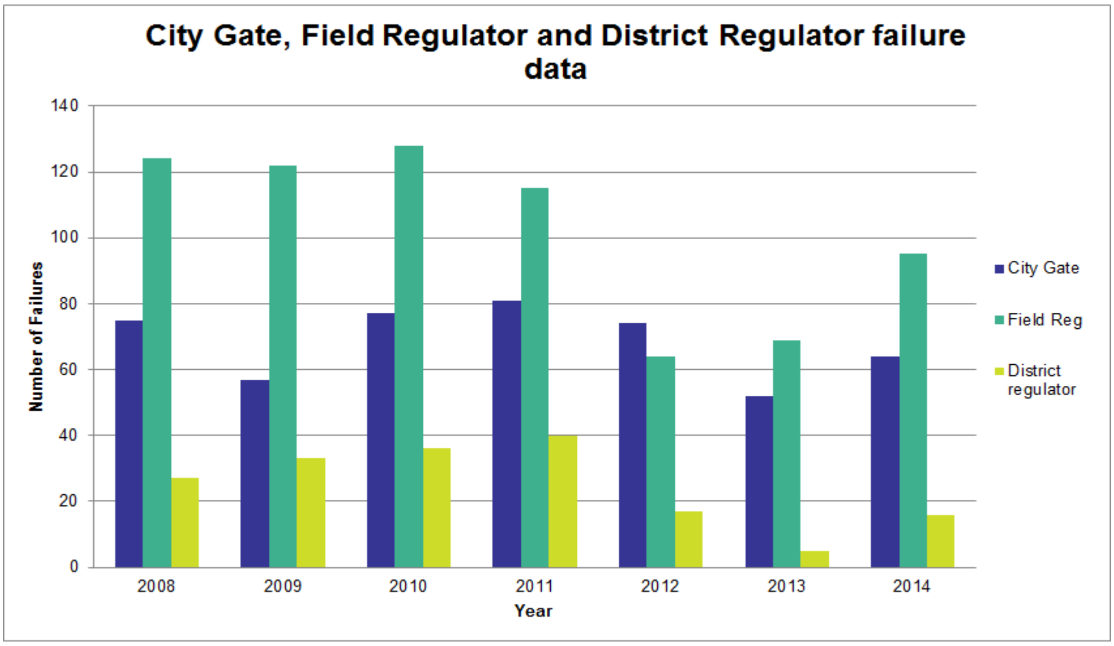
Figure 5: Heater Asset Age Profile



3.3 Historical Asset Performance

3.3.1 Failure Data

Figure 6: Historical Failure data, CG, FR and DR



3.3.2 City Gate Performance Review

The common city gate failures are associated with the Welker Jet and Jet Stream type regulators. These include leaking of hydraulic fluid, inability to hold a set pressure and even full component breakdown. With the introduction of the proactive replacement program for Welker Jet and Jet Stream regulators, prioritising the highest fault occurring sites, a significant decrease in the number of City Gate breakdown faults has occurred.

Other issues contributing to the city gate breakdowns include adjusting set points on regulators and specifically on the SCADA Control panel. Further works in this category include repairing minor gas leaks and undertaking works to rectify issues identified in operational checks such as the regulator not fully locking up. That is where there is no flow demand through the city gate station but the regulator leaks high pressure gas downstream.

3.3.3 Field Regulators

The most common breakdown associated with the field regulators is flooding of the underground pits. This does not create any operational issues with the field regulator however it can result in damage to the assets including corrosion to the field regulator pipe work and shorting of the electrical components including SCADA monitoring and control equipment.

To prevent these issues, the water within the pits is pumped as soon as it is identified. The Maintenance Contractor has in place a program to proactively visit pits prone to flooding post heavy rainfalls. Sites subject to frequent flooding also have alarms to alert the control room.

Other issues reflected in the breakdown data involves field regulator high pressure alarms being activated. These issues occur on field regulators feeding small residential networks. When there is minimal flow through the field regulator i.e. in non-peak times, the regulator closes which is known as lock up. These regulators, which are designed for high flow, and in some instances are aged and worn, cannot achieve 100% lock up and the high pressure on the inlet of the regulator will seep through. Over time the pressure rises on the outlet due to the lack of flow and in turn activates the high pressure alarm. This issue rectifies itself as soon as demand is placed back on the network. Works are taking place at some of these field regulators to tie the small network into other networks increasing the minimum flow rate through the site. This will prevent these over pressurisation incidents.

3.3.4 District Regulators

The major cause of district regulator faults is water related. Water affects the district regulators in two forms:

1 As most district regulators are located in underground pits, the pits fill up with water, especially after periods of heavy rain fall. Where diaphragm type regulators are used, a flooded pit means that water is acting on the diaphragm as opposed to ambient air conditions. This changes the operational physics of the regulator and results in a higher outlet pressure. When this occurs, the control room receives a high pressure alarm and dispatches a maintenance crew to investigate. Generally the maintenance crew pumps the water out of the pit and the regulator function returns to normal. To prevent this situation from occurring the Maintenance Contractor proactively visits district regulator pits prone to flooding after heavy rain fall to pump water out of the pit prior to causing further issues.

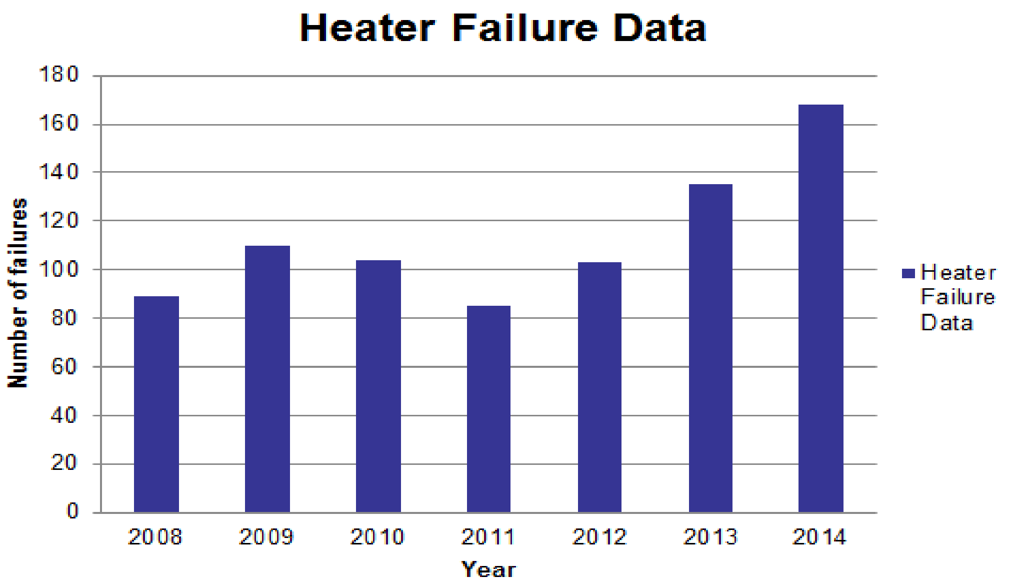
2 A common issue with the low pressure network is water entering the gas mains. This water can cause blockages in the gas mains resulting in customer outages. The water in gas mains also causes problems with the district regulators. When a water blockage of the main occurs close to the outlet of the district regulator, gas flow through the regulator stops and the regulator locks up. As the district regulators are aging and the working parts have worn, 100% lock up cannot be achieved, rather a trickle flow passes through the regulator. Over time this flow increases the pressure between the regulator and the water blockage as there is no flow of gas. Eventually a high pressure alarm will be triggered at the control room. A maintenance crew will attend the site and remove the water blockage.

The mains renewal program is targeting areas where water ingress is evident in the low pressure mains. This will reduce the occurrence of these issues.

3.3.5 Heaters

The heaters perform a critical function at city gate stations by preventing temperature related breakdowns which occur when gas temperatures fall below 0°C.

Figure 7: Heater Historical Breakdown Summary



The major cause of these breakdowns is when the pilot light is extinguished. When this occurs the heater is unable to start a burn cycle to heat the gas stream. This type of incident generates an alarm at the control room where a maintenance crew are dispatched to relight the pilot light. There are some heaters that have a high occurrence of breakdowns for pilot light failure particularly the Forsyth Rd City Gate Heater.

Bacchus Marsh heater has also had failures associated with the electrical heat elements. The elements have been shorting out one by one effectively reducing the maximum heating capacity of the site. It has now reached a critical point where the heater cannot provide the required heat energy to meet the flow rates of the city gate station.

Servicing has commenced on each heater be completed by a Type B appliance technician to meet the requirements of AS 3814 (Industrial and Commercial Gas Fired Appliances). This service is completed every 12 months and replaces one of the 6 monthly heater operational checks. During this service the combustion analysis of the burner and heater is analysed and adjusted as necessary. Appropriate operation of the flue and provision of adequate air supply to the burner is also checked and assured. This servicing was first undertaken in 2015 and seems to have increased the reliability of some of the worst performing heaters. As such this maintenance program will continue.

Other causes of heater breakdowns include low water level in the water bath heater and incorrect temperature settings of the heater.

4. Risk

4.1 Regulator Risk

Fire or explosion is a significant risk at city gate sites that creates the threat to the safety of the community and to maintenance personnel. This can be caused by Loss of pressure containment at a city gate, field regulator, or district regulator caused by physical damage to the station pipe work and components or degradation of the assets. Degradation of assets can be caused by corrosion of steel pipe work or worn soft spares including rubber seals of station components.

The consequence of fire or explosion is affected by several factors, but the most critical factor is the proximity of residential and commercial developments to the pressure reduction station. In order to maintain the safety of the surrounding community, encroachment around the pressure regulating facilities must be monitored to ensure new threats are adequately identified and mitigated.

Loss of supply through the facility resulting can cause customer outages. This failure can be caused when the city gate, field regulator or district regulator fails in the closed position, this will prevent gas from passing through the regulating station. As the regulator station is the injection point of gas into the distribution network, a loss of supply through the station will result in network pressures to drop and customer supply to be lost.

The impact of failure at regulator sites should all levels of redundancy fail could result in pressure 14 times greater than the maximum design pressure of the downstream system. This would result in major asset failures including that of distribution mains and services as well as residential meters and regulators. This would be a catastrophic situation with large amounts of uncontrolled gas being released and a high potential of injury to people and damage to property.

Likewise where the regulator fails in the open position and thus loses pressure control, the “slam shut” valve will be activated. The slam shut is one of the levels of over pressure protection built into each city gate and field regulator station. When the slam shut senses that the outlet pressure is too high, the valve will close shut stopping all supply through the city gate. The valve will reopen when the outlet pressure falls to a critically low level and the cycle continues until a maintenance crew attends the site and rectifies the problem. When the slam shut panel is activated, customers located on the fringe of the gas networks will lose supply.

The management of proactive replacement program for Welker Jet/Jetsream and Grove regulators is critical to the management of the above identified risks.

4.2 Heater Risk

Some of the key risks with management of the heater at city gate sites include:

Ice formation inside pipe work

Where moisture is present in the gas composition and the gas stream is exposed to sub zero temperatures, ice will form on the internal surface of the pipe. This ice can cause blockages of vital sense lines and seizure of moving parts in the regulators, rendering the regulator inoperable. This can either result in loss of supply through the city gate causing customer outages or loss of pressure control causing downstream pipelines to be exposed to a higher pressure than it was designed for increasing the potential for failure in the assets.

Ice formation on external pipe work

When the gas stream reaches sub zero temperatures, heat is conducted through the steel pipe resulting in the exterior of the steel pipe reaching sub zero temperatures. These cold temperatures cause moisture in the ambient air to condense or even freeze the external pipe work. This ice and moisture environment is conducive to corrosion of the steel pipe. Further, this ice can form around the external surface of valves and regulators making manual operation difficult.

As the pipe temperature fluctuates with the gas flow rate through the city gate station, the pipe work tends to expand and contract. This movement creates fatigue stresses in the pipe material. These stresses along with the corrosion issues reduce the life of the pipe and compromise the long term integrity of the city gate asset Hydrocarbon Drop out

When natural gas is exposed to low temperatures (i.e. temperatures below the hydrocarbon dew point of the natural gas), the heavier hydrocarbons within the gas stream begin to condense into a liquid oil substance. As the heavier hydrocarbons have a higher heating value than the lighter hydrocarbons, this drop out effect results in poor quality gas of low heating value being delivered to customers. The heating value is measured and monitored through the Wobbe Index which is a function of the gas heating value, the lower the Wobbe Index the poorer the quality of the gas. The minimum Wobbe index value is stated in Section 5 of the AEMO Gas quality Guidelines. By allowing these heavier hydrocarbons in the gas stream to condense, AusNet Services is at risk of breaching these guidelines. These liquid/oil slugs can also travel through the pipeline and cause damage to customer's appliances and AusNet Services' downstream assets.

These risks are managed through maintenance and replacement of heaters at city gates to ensure safety and quality of supply is maintained.

4.3 Welker Jet Regulator Replacement Program

4.3.1 Introduction

This program was initiated as there was a strong trend in the number of breakdowns associated with these types of regulators. Most of these faults are related to leaking hydraulic fluid which is the operating medium in these types of regulators. The maintenance plan actively identifies these leaks and the necessary repairs are performed prior to any faults escalating into a major incident. Should the leak be large enough or left unattended for extended period of time the pressure within the hydraulic circuit of the regulator will drop. This drop in hydraulic pressure compromises the regulators ability to reduce the pressure of the gas stream, resulting in regulator failure and the potential for over pressure in the downstream pipelines

Failures occurring at the "bung" where it breaks within the regulator are also typical. The bung is rubber plug which inflates and deflates in line with inlet pressure and flow fluctuations to maintain the constant set outlet pressure. The "bung" is the working part of the regulator which is responsible for the pressure reduction process. The failure of the bung results in hydraulic pressure loss and renders the regulator unable to reduce the pressure of the gas stream.

A review of these failures has found that the causes of these issues are:

1 The manufacturing process for spare parts i.e. bungs has changed which has resulted in reduced strength of the component.

2 The flow and inlet pressure characteristics of the city gate have changed through greater fluctuation of inlet pressure and flow demand. The maximum pressure setting of the hydraulic circuit must be increased to achieve adequate and safe regulator performance across the entire operating range of conditions

Given these findings, the Welker Jet and Jet Stream regulator replacement program was introduced with the installation of an alternative regulator that functions more appropriately to current conditions.

Since the introduction of the program faults have decreased. This has greatly increased the safety of these sites as well as reduced the operational expense required to attend to these reoccurring faults.

Strategy

Continue the replacement of Welker Jet and Jetstream type regulators at identified sites. Sites are prioritised by their high occurrence of failures.

4.3.2 Replacement Regulators

The replacement regulators include the Gorter R100 and the Pietro Fiorentini Reflux regulators. These regulators are designed to handle large pressure reductions and have exceptional turn down when dealing with large fluctuations in flow and inlet pressures. These regulators have a proven reliability on both AusNet Services' network and gas networks around the world.

For smaller capacity City Gate sites specifically those situated in kiosks where space constraints exist, Axial Flow type regulators are installed. In order to provide an alternative to the Axial Flow regulators, Pietro Fiorentini Apperflux regulators can also be utilised.

Figure 8: Ballarat CG Typical 2 leg wide open monitor configuration of Jet Stream Regulators

4.4 Grove Regulator Replacement Program

4.4.1 Introduction

Grove regulators are still operating at 3 of AusNet Services' City Gate sites and many Field regulator sites.

Grove regulators were installed as far back as the early 70's. As some of these sites are nearing the 50 year design life, some reliability issues have arisen. Further to this, Grove regulators are now obsolete and no longer supported by the manufacturer for spare parts.

As the Grove type regulators are now obsolete, the following issues arise:

- Spare parts required to maintain these regulators are no longer readily available;
- Spare parts have a limited shelf life; and
- In the event of maintenance required due to an emergency, parts are not available to undertake necessary repairs.

Incidents at grove regulators sites include failing to hold the required outlet pressure due to deterioration of the units in particular the "sleeve" which maintains the pressure control. The impact of failure at Grove regulator sites should all levels of redundancy fail could result in pressure 14 times greater than the maximum design pressure of the downstream system. This would result in major asset failures including that of distribution mains and services as well as residential meters and regulators. This would be a catastrophic situation with large amounts of uncontrolled gas being released and a high potential of injury to people and damage to property.

Subsequently this requires a maintenance crew to visit the site to re-adjust the regulator pressure setting resulting in additional OPEX costs. These failures are compounded by the issue with the procurement of spare parts which results in substandard components utilised in the regulator. This increases the likelihood of further regulator failures.

Strategy

Continue the Grove regulator replacement program at all identified City Gate and Field Regulator stations with a HP outlet pressure.

4.4.2 Scope

The replacement regulator used for Grove Regulators replacement program at identified city gate sites are Axial Flow type regulators or Pietro Fiorentini Apperflux Regulators. Field regulator sites for Grove replacement will be with Axial Flow type. Modifications are also required to the existing pipe work to enable the new regulators to fit into the existing installation.

Grove regulators are also installed at District Regulators (HP/MP to LP). The replacement of Grove regulator at District Regulators is not considered in this program as the District Regulators are being decommissioned as part of the Low Pressure mains replacement program.

The replacement program for industrial and commercial sites for Grove regulators can be found in the Regulator (Customer) Strategy.

4.5 Heater Replacement Program

The heater replacement program has been categorised based on the drivers for replacement:

- reliability and capacity;
- change in risk profile; and
- new heater installations.

4.6 Reliability

Bacchus Marsh and Forsyth Road heaters have been identified for replacement based on historical performance, and heater design not meeting the future capacity needs of the network. Heater re-builds of certain sections of the heater is required at Lara, Sydenham and Lancefield to increase the reliability of the heater.

4.6.1 Heater Replacement-Reliability

Bacchus Marsh Heater

This project is to replace the heater at the Bacchus Marsh City Gate. Bacchus Marsh City Gate is currently operating with an Electric Heat Tracing heater. The heater consists of heat tracing elements attached to external surface of the pipe. Recently the heating elements have been shorting out one by one effectively reducing the maximum heating capacity of the site. At the current rate of failure it is predicted that the heater will be incapable of meeting the required heating capacity by 2020 and as such will be required to be replaced in this year.

The Bacchus Marsh City Gate project includes the removal of the existing electric heater at Bacchus Marsh City Gate and the installation of a heat exchanger type heater. This type of heater consists of a shell in tube heat exchanger and a highly efficient condensing type water boiler. This type of heater has been used on the network at a number of city gate sites and has proven to be a reliable and efficient means to provide the heat requirements at city gate sites.

Forsyth Road Heater

The heater at Forsyth Road has become prone to breakdowns associated with pilot light failure, this results in a maintenance crew continually required to attend site to relight the heater. The forecasted growth associated with the Werribee network also results in the heater not being able to meet the capacity demand. The replacement heater with a modern water bath type heater will be able to meet the required long term flow capacity and improve the reliability.

4.6.2 Heater Re-build

There have been three heater sites identified that have failures and require replacement. When these heaters breakdown they are no longer operational until a maintenance crew attends site to check and reset the heater. These heaters are at Lancefield City Gate, Lara City Gate and Sydenham City Gate.

This program aims to replace the critical components within the heater system to increase the reliability.

Lancefield City Gate Heater – This is a heat exchanger type heater coupled to a boiler in which hot water is circulated through the system to transfer the heat to the gas flow. The major issue with this heater is that it overheats the gas when the gas flow rate is low. The heater detects this high gas pressure and locks out the heater operation as a safety mechanism. A maintenance crew is required to attend site and check the heater system prior to manually resetting the heater and starting the operation. To prevent this overheating of the gas the 3 way water valve is to be replaced with one that operates much quicker than the existing valve. Also logic will be programmed into the heater system that will modulate the boiler set point of the water temperature down when low flow is experienced.

Lara and Sydenham City Gate Heaters – The Lara City Gate is an old model water bath heater and the Sydenham City Gate is an old heat exchanger type heater. The issue with both of these heaters is that the pilot light extinguishes. This requires a maintenance crew to attend the site, check the heater and relight the pilot light. To fix this problem the entire gas train and burner of the heaters is to be renewed.

Strategy

Replace heaters that have reliability and/or do not meet the demand capacity with new modern water bath heaters to ensure adequate functionality of the heater and to minimise sub zero temperatures at city gate sites.

4.7 Change in Risk Profile

Due to the introduction of the APA compressor station at Winchelsea, the resultant APA transmission network operation has changed, resulting in the potential for some city gates sites to see maximum inlet pressure (maximum) of 10.2MPa rather than the typical design of 7.4MPa. Due to the Joule-Thompson affect the minimum temperature which can be seen at the outlet of these city gates is potentially -50°C. There is a material change in the risk profile as a result of the differential in inlet pressure, resulting in an outlet pressure of -50°C compared to -30°C. This results in an increased risk profile at the identified sites with the typical design of 7.4MPa of Wyndham Vale and Colac city gate.

To deal with this risk of the inlet to the city gate exceeding the minimum design temperature of the distribution network, a policy has been developed for the operation of City Gate Sites with Maximum inlet pressure of 10.2 MPa. This policy requires shutting the site down should the heater fail and city gate outlet temperatures fall below -30°C. This measure is to protect the distribution network from a brittle failure; however it may result in customer outages. All newly installed city gate sites have been designed in line with this policy.

Should the heaters fail at either Wyndham Vale or Colac City Gate at the same time a maximum inlet pressures are being experienced, gas temperatures at the outlet of the city gate station will fall to as low as -50°C. This carries the risk of a brittle failure on the downstream distribution network which is only rated to a minimum temperature of -30°C. As these sites have older heaters with no redundancy, the likelihood of having to shut the site down the sites is greater than if the heater had redundancy, and exposes the pipework to cooler temperature and therefore carries a greater risk of customer outages and failure of downstream pipework.

Strategy

Replace the existing heaters at identified sites with new water bath heater with redundant burner systems.

4.8 New Heater Installation– Vortex Type

4.8.1 Introduction

There are two city gate sites with no inline gas heaters. These sites are Ballan and Wallace City Gates. These sites have flow rate through these sites that are minimal, meaning the threats of low temperatures are not as apparent at these sites. Very rarely does ice or condensate form on the outside of the piping or valves as the heat transfer from the gas steam is so minimal and the ambient temperature is adequate to warm these surfaces. The hydrocarbon drop out volume is also negligible at these sites due to the minimal flow rates.

The concern at the two sites is ice formation on the inside if instrument tubing and pilot regulators. This can cause a blockage resulting in loss of pressure control and potentially over pressurisation of the downstream distribution network. Given the flow rates at both these sites it would be an inefficient expenditure to install and operate the standard type of heater such as a water bath heater at these city gate sites. A new heater technology available which will only heat the instrument lines is the Vortex type heater. This heater uses the frictional energy in the gas stream to generate enough heat to prevent freezing of moisture within the instrument tubing lines and pilot regulators. These heaters take up minimal space, can be installed with minimal modification to the station, do not need a fuel gas/electricity supply and need minimal maintenance compared to a water bath heater or heat exchanger.

Figure 9: Example of a Vortex Heater

Strategy

Install a Vortex heater on both pressure regulator legs at identified sites.

4.8.2 City Gate Lighting Installation Program Background

Should a heater failure occur at any of the sites listed in the works program below, a maintenance crew is required to immediately attend the site to identify the issue and get the heater operational again as quickly as possible. By providing adequate site lighting that can be switched on as required by the maintenance personnel, the chances of being to diagnose the issue and have the heater back operational is greater when incidents occur at night. Should the maintenance crew be unable to get the heater operational again, there is a potential for gas temperatures at the outlet of the city gate station will fall to as low as -50°C. This carries the risk of a brittle failure on the downstream distribution network which is only rated to a minimum temperature of -30°C. To mitigate the risk of a brittle failure, AusNet Services has instigated a policy for sites operating with a maximum inlet pressure of 10.2 MPa where the site is to be shut down should outlet temperatures fall below -30°C. In this case supply to customers will be lost. This program will decrease the risk of a brittle failure on the distribution network and decreases the risk of needing to shut down the station and loose supply to customers. This program aligns with Works Program

Strategy

Install 24 hour lighting of city gate sites that are subject to sites operating at a maximum inlet pressure of 10.2Mpa.

4.8.3 City Gate Lighting Installations Scope

The scope of this program is to install electrical lighting at each of the 5 city gate sites listed below in the works program. This lighting will consist of light pole in the vicinity of the heater control panel and a light mounted to the kiosk in front of the entrance. These lights will be located outside of the hazardous areas so they do not need to be rated for use in hazardous zones. These lights will be activated by a switch inside the entrance gate to each of the city gate sites.

5. Alignment with Network Objectives

5.1 Alignment with AusNet Services' Strategy and Corporate Plan

The drivers for the capital programs outlined in Section 5 below have been established to mitigate risks which would compromise the ability for the gas network to meet the above objectives and AusNet Services' Corporate Plan. These drivers are listed below:

Network Regulators Programs	Gas Network Objective			
	Maintain network Safety	Maintain operating efficiency	Undertake prudent & sustainable investment	Deliver valued services to customers
Welker Jet Regulator Replacement	●	●	●	
Grove Regulator Replacement	●	●	●	
Heater Replacement Program	●	●	●	●
City Gate Lighting Installation	●	●	●	

Gas Network Objectives
Maintain network safety in accordance with the Gas Safety Case;
The regulator replacement programs (Welker Jet and Grove) minimises failure through the replacement of regulators. This reduces the likelihood of loss of pressure containment, and minimises the safety risk to the public. Heater Replacement program: minimises failure through targeted replacement of poor performing heaters, reduces the downstream risk of pipe failure due to ice formation on pipework.
Maintain top quartile operating efficiency;
The program of works will maintain operational expenditure by increasing the reliability of the network regulator and heater sites, rather than the foreseen increase in expenditure if we do not replace high risk equipment.
Undertake prudent and sustainable network investment;
The benefits of this investment are to maintain the safety of the gas network and to maintain the reliability of supply to the end customer. Further to this, some of AusNet Services' Network Regulator facilities are reaching the end of their expected life. The works program is aimed at extending the life of these assets to ensure continued safe and reliable operation.
Deliver valued services to customers;
Maintain the reliability and quality of supply to the end customer, with a sufficient heating value to meet their energy needs.

6. OPEX Overview

6.1 City Gates Field Regulators and District Regulators

Operational Checks

This is a scheduled maintenance carried out every **6 months** in accordance with Section 2 of AusNet Services' System Operations Manual.

Full Maintenance

Full maintenance is carried out on a **3, 6 or 10 year** frequency with some sites on a breakdown only regime. The full maintenance frequency is assigned based on the criticality of the site within the network and failure history of the site.

Full maintenance entails the all aspects of the operational check as well as replacing all the soft spares within the regulator assemblies.

Breakdown Maintenance and Follow Work

Break down maintenance takes place whenever necessary where follow up work entails aspects which are identified during the routine maintenance but outside the scope of these works.

6.2 Heaters

Operational Checks

Operational Checks are scheduled to take place at the same time as the city gate operational checks and are to be conducted in accordance with Section 2 of the System Operations manual.

Further to this every alternate heater operational check is carried out by a Type B Appliance Technician. In addition to the above tasks, the following tasks are completed:

- Analysis of combustion gases is undertaken and assessed against the requirements of AS 3814.
- Undertake tuning of the combustion system to meet the requirements of AS 3814.

Full Maintenance

Heater full maintenance is also carried out at the same time as the city gate full maintenance in accordance with the System Operations Manual.

A heater coil replacement is carried out when an inspection indicates that corrosion on the coil is greater than that of the criteria outlined in AS2885.1. Generally heater coils are in good condition due to the maintenance of corrosion inhibitor levels in the water bath.

7. Detailed Works Plan

7.1 Phasing and Financial Disclosure

All programs within the Network Regulator Strategy are defined in calendar years, consistent with the requirements of the GDSC, and the reporting requirements of the Australian Energy Regulator (AER).[1]

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).

This section outlines the capital requirements for Network Regulator Facilities assets to 2024.

Table 5: Financial Summary

Program	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Welker Jet Regulator Upgrade	$400	$400	$350	-	-	-
Grove Regulator Replacement	$390	$390	$390	$1,050	$850	$780
Heater Replacement – Reliability	C-I-C	C-I-C	C-I-C	-	-	-
Heater Replacement – Change in Risk	C-I-C	C-I-C	C-I-C	-	-	-
Heater Replacement – New Installations	C-I-C	C-I-C	C-I-C	-	-	-
City Gate Lighting Installation Program	C-I-C	C-I-C	C-I-C	-	-	-
TOTAL Expenditure ('000)	**$1,780**	**$1,970**	**$1,240**	**$1,050**	**$850**	**$780**

[1] The AER requires notification of the outcomes of in-service compliance testing by 30 September each year. Both in-service compliance testing and meter replacement programs are defined, tracked and reported on a calendar year basis.

7.1.1 Welker Jet/Jet Stream Replacement Program

Table 6: Welker Jet/Jet Stream Replacement Program

Site	Name	2018/19	2019/20	2020/21	2021/22	2022/23
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	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	
	Total	**$400**	**$400**	**$400**	**$350**	**$0**

7.1.2 Works Program Grove Regulator Replacement

Table 7: Grove Regulator Replacement Program

CIC

7.1.3 Heater Replacement Program

Table 8: Heater Replacement Program

Category	Site	Name	2018/19	2019/20	2020/21	2021/22	2022/23
Reliability	P4-5003	Lancefield Heater Retrofit	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
	P4-112	Lara heater rebuild	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
	P4-251	Sydenham heater rebuild	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
	P4-128	Forsyth Rd City Gate	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
	P4-104	Bacchus Marsh City Gate	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
Change in Risk	P4-5013	Wyndham Vale City Gate	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
	P7-5000	Colac City Gate	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
New Heater Installations	P4-103	Ballan City Gate	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
	P5-007	Wallace City Gate	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
		Total ($'000)	**$ 890**	**$ 1,180**	**$ 500**	**$ -**	**$ -**

7.1.4 Lighting Installation Program

Table 9: Lighting Installation Program

Site	Name	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
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	C-I-C	C-I-C	C-I-C	C-I-C	C-I-C
	Total ($'000)	**0**	**$ 100**	**$ -**	**$ -**	**$ -**	**$ -**