Code of Practice

Upstream Polyethylene Gathering Networks – CSG Industry

Companion Paper CP-08-003

Leak Test Methods

Rev 1

October 2019

Important note on use of the *APGA Code of Practice for Upstream Polyethylene Gathering Networks in the Coal Seam Gas Industry*.

This Code of Practice has been developed for the use of organisations involved in the CSG industry, primarily in Australia and New Zealand.

Contents

Acknowledgements

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Feedback on this Companion Paper or recommendations for the preparation of other Companion Papers is encouraged.

A form has been provided to enable the submission of feedback. The form can be found on the APGA website under Publications or by following this link https://www.apga.org.au/apga-code-practice-pe-gathering-networks-queries-and-proposed-updates-form

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Preface

Companion Papers have been developed by the Working Group responsible for the *APGA Code of Practice for Upstream PE Gathering Networks – CSG Industry* (the Code) as a means to document technical information, procedures and guidelines for good industry practice in the coal seam gas (CSG) industry.

Since 2008, the development of the LNG export industry based in Gladstone, Queensland, with its related requirement for a large upstream CSG supply network of pipelines and related facilities presented the impetus for significant improvements in design and best practice approach.

The principal motivation since the initial development of the APGA Code of Practice was safety and standardisation in design and procedures and to provide guidance to ensure that as low as reasonably practicable (ALARP) risk-based requirements were available to the whole CSG industry. Accordingly, the Code is focused solely on this industry and the gathering networks and associated pipelines using locally manufactured PE100 pipeline. The Code is a statutory document within Queensland.

The incorporation of Companion Papers since Version 4 of the Code is intended to provide information and best practice guidelines to the industry, allowing the Code to be limited to mandating essential safety, design, construction and operation philosophies and practices.

Companion Papers form part of the suite of documents together with the Code and are intended to:

a) be used in the design, construction and operation of upstream PE gathering networks;
b) provide an authoritative source of important principles and practical guidelines for use by responsible and competent persons or organisations; and
c) assist the gas industry to become a positive and valuable member of the community including landholders.

Companion Papers should be read in conjunction with the requirements of the Code to ensure sound principles and practices are followed. These documents do not supersede or take precedence over any of the requirements of the Code.

A key role of the Companion Papers is to provide the flexibility to incorporate endorsed industry practices and emerging technologies expeditiously, as/when necessary.

A related benefit is that the Companion Papers can be referenced by the wider resources industry which uses similar PE gathering networks for gas or water handling, including coal bed methane (CBM) in underground coal mines; mine de-watering; the emerging biogas industries (agricultural, landfill, etc.); or any development with similar characteristics (e.g. shale gas).

Other useful references to support CSG Field Development include:

- Agreed joint arrangements between the Landholder and operating company as detailed in Conduct and Compensation Agreements;
- Queensland Government Acts and Regulations, developed in association with the industry, covering the direct and indirect issues from the beneficial use of CSG

produced water to weed management, monitored by the Gasfields Commission (under its own Act); and

- Safer Together publications which address many of the industry-wide issues, specifically standardised inductions; 4WD vehicle usage and monitoring and heavy vehicle Land Transport, in particular drilling and construction water transfer and handling.

1 Scope

The scope of this Companion Paper is to provide detailed requirements of leak test methods defined in Section 8 of the Code. This Companion paper only covers leak test methods for pneumatic leak testing. Pneumatic leak testing includes tracer gas test, allowable pressure loss (pneumatic pressure decay test) and other proven/approved methods.

Leak test methods for Hydraulic Leak Testing are fully covered in AS/NZS 2566.2 Appendix M5, M6, M7 and M8 for constant pressure test, pressure decay test, pressure rebound test, and visual test for small pipelines respectively.

Section 8 of the Code allows for test methods other than those addressed in this Companion Paper to be used but those other methods shall be determined based on risk evaluation and the test method shall be approved.

2 General

The intent of the leak test is to determine if there are any small leaks in the network. Leak testing is recommended to be undertaken where possible immediately after successful completion of a strength pressure test. It is noted that in some circumstances this may not be possible.

Exclusion zones are not normally required for leak tests as the network section being tested has been proven to have adequate structural integrity with no significant leaks as a result of a successful strength test. However, it is recommended that exclusion zones should still be maintained around above-ground pipe sections and testing equipment to keep unauthorised people out of the area during leak testing activities.

The following general principles apply to the design, conduct and acceptance of a leak test:

- The section being tested shall not contain a detectable leak.
- Due to the compressibility of air (pneumatic test only) and pressure fluctuations due to the effects of creep, temperature and barometric pressure, it is possible to have a leak on a system which will not be apparent on the test equipment. Therefore, when considering the test duration the following should be taken into account:
    a) volume of the system
    b) ambient and ground temperatures
    c) barometric pressures
    d) creep (relates to pipe SDR and material).

Pressure drop due to creep depends upon the pipe material, ambient temperature, SDR, any previous stress history and the degree of restraint offered by the backfill. It does not vary with pipe volume.

If the temperature of the gas in the pipeline being tested changes there will be a gain or loss in the recorded pressure in the pipeline. This effect can be calculated and if necessary the difference in pressure due to temperature can be added to the total pressure loss effect.

3 Pneumatic Leak Test

There are three methods nominated for pneumatic leak test: tracer gas test, allowable pressure loss test and other proven / approved method.

3.1 Tracer Gas Test

Tracer gas surveys are normally conducted as a leak test following completion of the strength test using an approved gas which has traceable capabilities. At present, the three main tracer gases available are:

- helium (usually 1 per cent in nitrogen)
- nitrogen 95 per cent / hydrogen 5 per cent mix
- methane (CSG).

The acceptability of this method shall be tested by suitable trials approved by the operator. The trial shall take into account the time taken for the tracer gas to travel from a leak in the test section to the surface and that the pressure in the test section of the tracer gas mix and the detection equipment is appropriate to locate the leak. Environmental conditions such as wind and rain as well as the speed of travel over the section under test need to be considered.

For existing networks where the ground has fully compacted over long periods of time, consideration should be given to the time for tracer gas to permeate though the ground. In some circumstances, further planning may be required where sniff tubes are inserted at either side of road/ river crossings and paved areas, and inserted at strategically placed points along the system, especially in the vicinity of vulnerable areas such as welded and mechanical joints.

When planning a tracer gas survey consideration should be given to the type of tracer gas used. For example the use of methane as a tracer gas may incur problems when a leak has been detected and the system may require de-commissioning with an inert gas to carry out the repair.

The tracer gas shall be introduced into the test section at the manufacturer's recommended concentrations. The entire test section will require a full purge to ensure the gas is uniformly distributed and the test section pressure is a minimum of 100 kPa. Consideration should be given to the soak time as the higher the pressure the quicker the tracer gas will permeate through the ground. After a suitable time has elapsed to allow the tracer gas to permeate through the ground, a tracer gas survey shall be conducted by passing a suitable gas detector over the surface of the ground above the test section to detect any leakage. Careful planning is required to survey the entire test section and to ensure that the speed of the detector allows the capture of all leaks. A typical manufacturer's recommendation is that this speed be no more than 2.5km/hr. It is good practice to have marker pegs along the route of the test section to guide operators as to direction.

The gas detector used shall be suitable for this application and calibrated for the desired tracer gas application. Attention should be given to untested joints, sealed roads and pathways where a snoop tube is normally inserted above the joint and at either side of the road crossings.

When using nitrogen in leak testing, the danger of asphyxiation needs to be taken into account, especially when working in confined spaces. Vent stacks and pipes should be positioned at least 2 metres above-ground in order to achieve a safe atmosphere. Personal gas monitors shall be carried by operators during this testing.

3.1.1 Acceptance Criteria

The test section will pass the leak test if no detectable leaks are located with the gas detector.

3.2 Allowable Pressure Loss Test (Pneumatic Pressure Decay Test)

In order to achieve an acceptable pneumatic pressure decay test the volume should be kept as low as possible as leaks will be more apparent. Generally, all tests on sections with large volumes should be held to a minimum leak test period of 24 hours. This will result in a full temperature cycle of the test section to be completed.

The longer the test period is, the more certain the detection of leaks, so for very large volume test sections the duration of the test may need to be extended.

3.2.1 Leakage effects

Any leak on a test section will result in a loss of pressure. However the effect of small leaks can be masked by creep and temperature effects.

Therefore the duration of the test needs to be of sufficient time to determine if any leaks are present.

3.2.2 Acceptance criteria

The total pressure loss or gain over the test period is related to the temperature change, creep and leakage of the test fluid. When leak testing over long durations, pressure will normally follow the trend of the barometric and internal pipe temperature as the elasticity of the pipe will be significantly less at lower pressures.

The acceptable volume loss is 1 litre/hr/actual m3 volume of test fluid.

NOTE: The word ‘fluid’ in this context means air or other gaseous medium.

Appendix B1 of the Code details the calculation process for this test method.

3.3 Other proven / approved method

Other methods of leak detection including acoustic testing are available or are being developed. In order to use any of these methods, the acceptable criteria need to be approved by the Operator including verification of contractor competency as well as method verification by technical assessment and testing.