Industry Guideline:

Gas Infrastructure in Bushfire Prone Areas

ENA DOC 043-2018

Energy Networks Australia

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Acknowledgements

The Energy Networks Australia Gas Technical Reference Group has broad national representation from a number of industry representatives and has access to a large database of industry guidelines, policies, reference standards and design manuals.

Energy Networks Australia has Members across Australia's electricity distribution and transmission and gas distribution companies. For the development of this guideline the following industry organisations were represented on the Reference Group:

- ATCO Gas Australia
- AusNet Services
- Australian Gas Infrastructure Group (comprising of Australian Gas Networks, SA, Australian gas Networks VIC and MultiNet Gas)
- evoenergy
- Jemena
- TasGas

Documents of Energy Networks Australia

History of Energy Networks Australia

Energy Networks Australia is the peak national body representing gas distribution and electricity transmission and distribution businesses throughout Australia. It began trading under this name on 10 November 2016, but commenced operations as the Energy Networks Association (ENA) in January 2004.

It replaced the Australian Gas Associations Network Operators Committee and the Electricity Supply Association of Australia's Distribution Directorate, and assumed the representational functions of these two associations on energy network issues. In January 2016, the Energy Supply Association (esaa) became jointly owned and managed by the Australian Energy Council and Energy Networks, and its Board now consists of representatives of the Australian Energy Council and Energy Networks. At the same responsibility for Grid Australia's activities on behalf of the electricity transmission sector were also absorbed.

With more than 13 million customer connections across the National Energy Market (NEM), Australia's energy networks provide the final step in the safe and reliable delivery of gas and electricity to households, businesses and industries. This document helps protect delivery of these services.

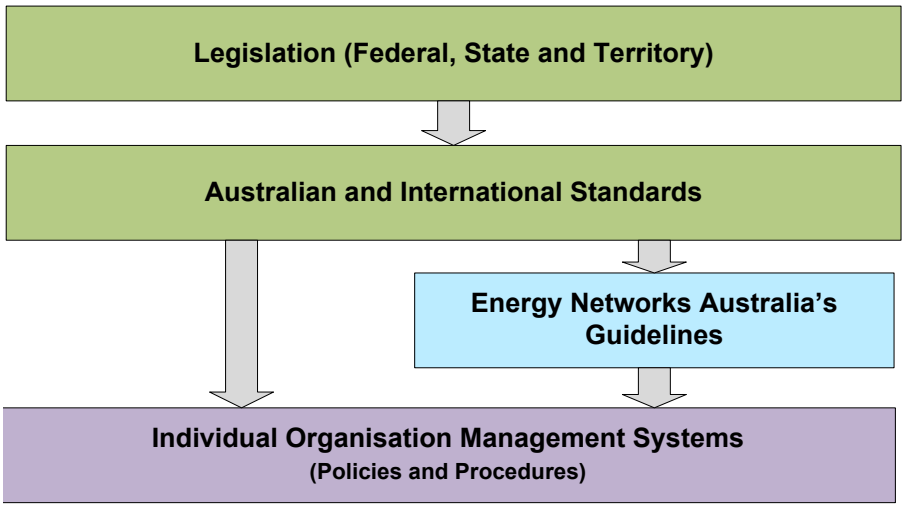
Documents

Part of the role of Energy Networks is the development and management of support material such as codes, specifications, guidelines and handbooks to support the energy industry and members of the public in the interpretation and application of legislation and

standards. All documents are written in collaboration with the industry through reference groups and general consultation with the Members of Energy Networks.

This guideline is just one document in a framework of information designed to support the energy sector. The following diagram shows the relationship between Energy Networks Australia's documents and the legislation, standards and individual organisations' procedures. Codes and specifications (blue boxes) contain mandatory requirements for the industry with guidelines and handbooks (purple boxes) related to good practice application and decision-making.

Figure 1: Energy Networks' Document Structure (Gas Networks)



This guidelines does not contain mandatory information. It should be noted, legislation and standards may alter between editions of Energy Networks Australia documents, and they will always take precedent. As such all document users must be aware of the current regulatory environment.

Definitions and Abbreviations

Definitions

All Energy Networks Australia documents utilise a single definition list located on the Energy Networks Australia website. This is to ensure all documents use consistent definitions across Energy Networks Australia documents. This is not an attempt to define all terms in the energy industry and organisations may use different definitions. It provides consistency across documents authored by Energy Networks.

Abbreviations

All Energy Networks Australia documents utilise a single abbreviations list located on the Energy Networks Australia website. This is to ensure all documents use consistent abbreviations across Energy Networks Australia documents.

Application

This document applies to members of the industry engaged in the management of gas distribution networks.

Referenced Documents

The following documents are referred to in this document:

Document Code	Title
AS/NZS 4645.1: (2018)	Gas Distribution Networks – Part 1: Network Management
AS 3959	Construction of building in bushfire-prone areas
AS 2885 (suite)	Gas and Liquid Pipelines
AS/NZS 5601.1	Gas fitting
GPA16484-REP-004	ENA Gas Distribution Networks Bushfire Threats Evaluation

1 Introduction

1.1 Objective

The objective of this guideline is to provide informative material that can be used for development of plans for the management of gas infrastructure in bushfire prone areas across the lifecycle of that infrastructure. The informative material in this guideline is as an adjunct to the relevant Australian Standards, in particular AS4546.1 and can provide a nationally consistent approach for the management of gas infrastructure in bushfire prone areas.

This document is intended to complement, but not substitute or override, relevant regulations and Australian Standards.

Energy Networks Australia recognises the governance requirements for the development of Australian Standards and thus the time that may elapse between updates of Standards. The guideline, therefore, may also serve as a reference for lessons learnt from research, incidents or other jurisdictions/industries that will be included in future review of Standards

This document does not stipulate prescriptive details in the design, construction, operation, maintenance and disposal of gas distribution assets in bushfire prone areas. Consistency of approach in the detail will be delivered by way of this document together with the relevant legislation, codes and standards. Individual organisations will then establish their own safety management systems together with the attendant design standards and detailed manuals.

The key objective of this document is to provide guidance to enable network operators to meet the following requirements:

> *Where network operators have identified segments of their distribution network located within or service bushfire prone areas that the risk of a gas distribution network failure as a direct result of a bushfire has been evaluated and appropriate measures deployed to ensure an acceptable level of risk.*
>
> *The assessment of risks associated with bushfire threats shall consider the likelihood and nature of a potential bushfire in a given location and be aligned with approved Australian Standards, such as AS 3959 or local legislative and/or planning requirements.*

1.2 Scope

The document provides a basic overview of management of gas distribution infrastructure in bushfire-prone areas. This document is limited to extent of gas distribution networks as defined in AS4645.1. It does not cover upstream infrastructure (generally under the AS2885 suite of standards) or downstream of the gas distribution networks (generally covered by AS/NZS 5601.1) or the requirements of BCA or similar.

1.3 Background

In 2017, Energy Networks Australia commissioned the Energy Pipelines Cooperative Research Centre, EPCRC, (in collaboration with GPA Engineering Pty. Ltd) to deliver a research study evaluating the threats posed to gas distribution networks from bushfires.

As part of this work, a risk validation workshop was completed which assessed, based on input from gas distribution network operators, the relative risks of failure for different consumer connections and configurations in bushfire prone areas. The specific risk that the study reviewed was:

> ***The risk to public safety, loss of supply and the environment associated with a loss of integrity of a gas distribution piping system or equipment as a direct result of a bushfire.***

The key findings of the research study have been incorporated into this guideline.

2 Guidance for Bush Fire Prone Areas

2.1 Gas Assets Fire Failure Mechanisms

Gas equipment failure mechanisms result from high radiation exposure based on a typical heat flux profiles for bushfires include:

1. Failure of sealing path on threaded joints due to PTFE thread tape destruction (Restricted Venting Rate).
2. Failure of gas regulator diaphragms leading to venting through regulator vent port (Restricted vent rate but higher than Failure 1).
3. Failure as per Item 2, with localised ignition leading to flame impingement on the regulator or gas meter for a prolonged period ultimately leading to a more catastrophic failure and full bore release.
4. Leakage from isolation valve stem and bonnet seal (Restricted Rate as per Failure 2).
5. Significant damage to consumer meter due to melting of components and potential catastrophic failure of components (Potential Higher Flow Release).
6. Full downstream piping failure due to downstream piping exposure to flame front and higher radiation heat flux leading to pip connection failure (High Flow Full Bore Release).

These types of failures have all been witnessed in Australian bushfires.

2.2 Inputs for AS4645 FSA

To aid network operators in the qualitative assessment of the risk of a bushfire event leading to an escalated safety incident caused by the subsequent failure of an element of the gas distribution network supply to a consumer premises indicative levels of risk have been documented for a number of locations based on the AS 3959 Bushfire Attack Level, (BAL), classification.

To determine the risk levels, the following assumptions are considered applicable in this context:

- Incremental environmental and extended loss of supply consequences due to the subsequent failure of an element of the distribution network following a bushfire were considered “trivial” and “minor” respectively based on the AS/NZS 4645 definitions, given the initial impact of the bushfire itself.
- Incremental safety consequences under the same scenario were classified as “severe” based on AS/NZS 4645 definitions. “Severe” represents a consequence involving hospitalisation but not likely to cause a fatality. This was considered appropriate based on the nature of an ignition event subsequent to the passing of the bushfire given consideration of the relatively small radiation zones associated with low pressure gas fires and the ability of a person to escape the danger zone should it occur.

- It was assumed the likelihood of a system failure induced incident, given the bushfire had already occurred, was then aligned with the AS 3959 BAL such that the likelihood was assumed as ranging from "remote" for BAL-12.5 and BAL-19 risk areas to "high" for BAL-FZ areas. This was agreed based on the understanding that the method for assigning BAL is in itself a risk based method evaluating the likelihood of a bushfire with a particular intensity occurring at a specific location. Given that the higher the radiation intensity of a bushfire the more likely a gas distribution component failure, this alignment was considered by the workshop as appropriate.

2.2.1 Inherent Risk Levels

With the above assumptions applied, the inherent risk for a location subject to a bushfire where no specific mitigation measures to protect against bushfire threats had been applied are outlined in Table 2 below.

Table 2: AS 4645 Qualitative Inherent Risk Levels

AS 3959 BAL Classification	AS 4645 Likelihood of loss of Containment due to Bushfire Threat	AS 4645 Safety Consequence Category (Burns Injuries)	AS 4645 Risk Level
BAL-LOW	Hypothetical	Severe	Negligible
BAL-12.5	Remote	Severe	Low
BAL-19	Remote	Severe	Low
BAL-29	Unlikely	Severe	Intermediate
BAL-40	Occasional	Severe	Intermediate
BAL-FZ	Frequent	Severe	High

2.2.2 Risk Levels with Controls Applied

A number of specific mitigation and prevention measures exist (and are utilised) that network operators could apply specifically to reduce the risks associated with network failures caused by bushfires. These measures are discussed in Appendix 1 as potential measures that may be implemented to reduce the inherent risks to an acceptable level.

These measures included:

1. Equipment specified of materials of construction that are fire resistant.
2. Equipment located a distance from structure and vegetation that could be ignited by a bushfire.
3. Equipment enclosed or shielded from radiation and flame impingement OR located below ground.
4. Fire Stop Thermally activated or Excess Flow Valves installed.
5. Network segment isolation and/or pressure reduction facilities provided for high fire risk areas.
6. Emergency response plans and procedures.

Where isolation of gas supply to an area at imminent risk of bushfire is implemented as part of an emergency response plan for dealing with a bushfire incident, due consideration must be given to not interrupting gas supply to critical sensitive assets such as hospitals or aged care facilities not at immediate threat from the bushfire.

If network operators implement an appropriate selection of the above measures, residual risk levels could be reduced to those summarised below in Table 2.

Table 2: AS 4645 Qualitative Residual Risk Levels

AS 3959 BAL Classification	AS 4645 Likelihood of loss of Containment due to Bushfire Threat	AS 4645 Safety Consequence Category (Burns Injuries)	AS 4645 Risk Level
BAL-LOW	Hypothetical	Severe	Negligible
BAL-12.5	Remote	Severe	Low
BAL-19	Remote	Severe	Low
BAL-29	Remote	Severe	Low
BAL-40	Unlikely	Severe	Intermediate
BAL-FZ	Occasional	Severe	Intermediate

The above assumed that the application of appropriate and practicable risk reduction measures would reduce the likelihood of an escalated safety incident by an approximate order of magnitude in most cases.

2.2.3 Guidance for New Developments:

When planning and designing gas distribution networks for supplying areas that have been deemed prone to bushfire via assessment by AS 3959 and/ or equivalent planning guidelines, the network design should consider the following:

(a) Specific design requirements to lower the risk of a distribution failure when exposed to bushfires (refer above protection measures).

(b) Provision for safe and ready isolation of the main gas supply to the development without impact neighbouring consumers not located in the bushfire prone zone.

(c) The development of formal emergency response plans for dealing with bushfire incidents at the specific location.

3 Conclusion

AS/NZS 4645(2018) *Gas Distribution Networks* does not provide specific requirements or guidance with respect to managing bushfire threats to gas distribution assets other than requiring above ground risers to be metallic and that bushfire threats should be considered by network operators in their overall network operational risk assessments.

These guidelines provide flexibility in the measures able to be adopted by network operators in managing bushfire threats to their network, to enable the measures deployed to be appropriate to the anticipated risk levels and practical to implement.

Appendix 1: Bushfire Protection Measures

Based on a review of current Australian and International practices the following specific measures to protect against bushfire attack of gas distribution network elements have been reviewed as part of the research into bushfire effects on gas distribution networks.

The measures have been categorised in two classes;

1. Those that can lower the probability of an initial component failure, and
2. Those that can mitigate the consequences following a failure by limiting or preventing further gas release.

Protection against Failure

The following options for measures improving the actual survival rate of consumer gas meter- regulator sets under a bushfire attack scenario may be considered.

Materials of Construction

Manufacturers of meters, regulators and valving offer various material options with some able to offer greater resistance to heat in fire situations. The cost of an alternative material specification needs to be balanced with the actual risk within a specific context and location for justification but specification with fire resistance as an explicit requirement remains an option.

Location and Vegetation Clearance

Specifically locating the meter-regulator facilities as far as practical from structures that may catch on fire as a result of an approaching bushfire in vegetation cleared areas is an option if practical for reducing the maximum heat-flux and duration of exposure for equipment in the vicinity of a bushfire.

Meter-regulator Enclosures

The installation of gas equipment within fire resistant metallic enclosures or under equivalent fire resistant covers provides shielding from indirect radiation and direct flame impingement.

Below-ground Metering and Regulator Pits

Although not commonly encountered in the Australian context, this means of preventing exposure to the higher radiation levels encountered in a bushfire threat scenario may be considered.

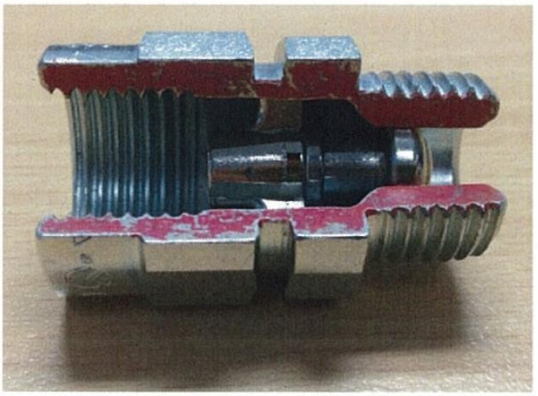
Prevention of Escalation after Failure

The following options for measures reducing the consequences of a damaged consumer connection following the passing of a bushfire front have been identified and may be considered as controls.

Fire Stop Valves

A fire-stop valve is a valve that when exposed to high temperature conditions, "shuts off" to isolate gas flow passed its safety seat. The valve when activated allows a plug to be pushed up into the valve forming a metal to metal seat. The valve is not resettable and must be replaced following operation. It will be typically located in the above ground consumer connection immediately downstream of the first isolation valve to allow replacement.

It should be noted that some manufacturers are building this functionality into their regulators when specified with a fire-safety option.



Excess Flow Restrictors / Stop Valves

Installation of an excess flow valve in the gas service tee or in the consumer service piping. In the event of a line break due to interference or damage by fire in this case, the excessive flowrate through the line will cause a high differential pressure that acts against a pre-set spring tension that closes off the valve, preventing further gas release.

A small bleed hole in the valve seat design allows the pressure across the valve to equalise once the gas release is stopped which allows this valve to automatically reset so that service can be restored without need for replacement.

① Shut-off element
PPS (polyphenylene sulfide)
② Flow element
PPS (polyphenylene sulfide)
③ Seals
NBR (nitrile-butadiene-rubber)
④ Spring
Stainless steel
⑤ Housing-Adapter
PE 100 – SDR11 (polyethylene)

Fig. 11

Distribution Network Zone Isolation and Pressure Reduction

The provision of field regulator and isolation points in a network segment feeding a high fire risk area permits either pre-emptive or post event lowering of network pressure and/or complete isolation to reduce the likelihood of excessive gas release following a bushfire event.

Emergency Response Planning and Proactive Measures

Specifically tracking fire progress with predetermined response plans providing isolation procedures for network segments, community consultation with advice on isolating gas supplies when evacuating due to bushfire etc., are proactive response measures that act to reduce the risk of escalation a bushfire threat event due to failure of gas distribution network elements. Several Australian distribution network operators have employed these procedures together with tools such as live GIS overlays of fire services data on network distribution maps to coordinate fire response plans.

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