Australian Standards Compliance Provisions Report

DSD Advice - Imported Gas Compressor Packages - Compliance to Australian Standards

Department of State Development (SA)

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EXECUTIVE SUMMARY

The South Australian State Government is involved in promoting economically sustainable, safe and environmentally friendly developments in the oil and gas sector in South Australia.

As part of this initiative, there is a desire to ensure that Australian Oil and Gas companies can leverage the commercial and operational benefits of "proven in use", foreign packaged equipment that is deemed to not compromise safety but that may not fully comply with Australian Regulations, Standards or Codes of Practice.

An area of particular concern surrounds Australian Standards' requirements for Packaged Gas Compression Equipment which are considered more onerous than the requirements imposed by North American or Canadian Standards.

The scope of this report is summarised as follows:

- To review existing Australian legislation and national standards relating to the installation of electrical equipment in hazardous areas, and the requirements for industrial gas fired appliances, which include stationary gas engines and turbines.
- To provide an overview of the key requirements of these standards and their alignment with international standards.
- To specifically address potential compliance issues when compared with equivalent North American / Canadian standards.
- To provide recommendations on whether exemptions or concessions from the requirements of the Australian legislation and standards should be formally granted, allowing direct import of foreign packaged compression equipment or, to indicate how the Australian requirements may be satisfied without compromise.
- To address the specific concerns of a Canadian Compressor Supplier, SAGE Energy Corporation, with respect to Australian Standards' compliance requirements as documented in a letter to Michael Malavazos – Director of Engineering Operations Energy Resources Division – Department of State Development South Australia.

Based on GPA's specific review of the standards in the preparation of this report and extensive experience working in the Australian on-shore oil and gas industry the following observations are made:

- Australian authorities have made significant progress in aligning Australian Standards with internationally accepted standards and in particular the IEC standards as they apply to hazardous areas. Australia is a signatory to the World Trade Organisation Technical Barriers to Trade, (WTOTBT) Code of Good Practice for the Preparation, Adoption and Application of Standards, committing to the utilisation of international Standards wherever possible.
- With respect to hazardous area regulation, Canada and the USA have acknowledged the need to align themselves with foreign standards to allow trade on an international basis and are moving towards adherence to IEC standards. This is optional in the USA but mandatory for all new hazardous installations in Canada.
- Where Australian standards deviate from international standards, including specific requirements of AS3814 and competency and certification requirements for hazardous area electrical equipment as detailed in AS60079.14, the additional requirements have been included in an attempt to achieve a higher level of safety and documented traceability that may be achieved if the requirements are relaxed.

- In most cases the Australian standards provide the flexibility to allow deviations from the "letter of the standards" provided a documented case is presented that demonstrates safety is not compromised by the alternative design.
- Although open to interpretation, GPA's experience and opinion is that for packaged equipment that is essentially identical across multiples units, these documented justifications need only be made on a once off basis for each standard design, thus not representing a significant cost impost to foreign importers wishing to establish facilities in Australia.
- With respect to local assembly and packaging in Australia, there is a decided advantage in adherence to Australian standards due to a large pool of trained and certified tradespersons, familiar with the local standards being locally available.

Specific observations with respect to hazardous area compliance and Type B gas appliance requirements presented for consideration by foreign equipment suppliers include:

- With respect to AS3814 and Type B appliance certification; provided a written case is made, supported by risk assessment, that the foreign equipment supplied provides an equivalent level of safety and risk to that if it were fully compliant, then the Australian standard allows flexibility in its approval. Acceptance of equipment to foreign standards is reliant on a documented case being presented to the technical regulator. For an OEM supplying packaged equipment, this case can be documented <u>once</u> and submitted for each equipment package provided they are equivalent.
- With respect to AS60079.14 hazardous area equipment conformity assessment and OEMs; GPA believes that although the Standard requires unique conformity assessments based on specific applications, in the case of packaged equipment which is of a standard reproducible design that is repeatedly installed in typical operating environments, it is acceptable to obtain Conformity Assessments for the standard design on a once off basis and present this for inclusion in site specific hazardous area dossiers.
- With respect to the classification of hazardous areas within engine and turbine enclosures to AS/NZS60079.10.1; For enclosures where there is a high degree of ventilation due to engine cooling requirements, a detailed analysis of gas dilution and resultant gas concentrations that may develop in the enclosure due to fugitive emissions and/or specific credible leak scenarios in conjunction with active gas detection and high integrity fuel isolation external to the enclosure may justify that any resultant hazardous area zones within the enclosure are limited to Zone 2 of "negligible extent". By using the first principle method presented in AS/NZS 60079.19 Annexure C this may allow the space within the enclosure to be treated as a non-hazardous area provided the assessment is supported by a detailed documented risk assessment.
- Fugitive emission studies to API505 standard are acceptable in making cases for the derating of zonal classifications in enclosed areas but must be presented in the context of an overall risk assessment and justification.
- For consideration by Australian standards authorities; GPA believes there is scope to consult with the relevant Standards Australia technical committee for AS/NZS60079.14 to explore whether the acceptance of ATEX declarations may be relaxed based on specific constraints surrounding their certification without requiring a Conformity Assessment given that the underlying EN and IEC standards are generally aligned. This would also align the Australian and New Zealand requirements for non-IECEx certified equipment.

Based on the above, GPA does not believe there are compelling reasons to justify generalised waivers or amendments to Australian standards with respect to foreign equipment. Rather where a deviation is not able to be practically addressed by redesign due excessive cost or design constraints, a documented case accompanied by a risk assessment addressing the non-compliance is acceptable to technical regulators and provided for by existing flexibility in the standards in most cases.

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1 DOCUMENT SCOPE

The South Australian State Government is involved in promoting economically sustainable, safe and environmentally friendly developments in the oil and gas sector in South Australia.

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2 BACKGROUND AND INTRODUCTION

In 2012 the South Australian Government published a Roadmap for Unconventional Gas Projects in the state. The Roadmap was informed by a public and industry stakeholder engagement process with the formation of a Roundtable for Oil & Gas, (Formerly the Roundtable for Unconventional Gas Projects in SA), which now includes involvement from over 850 organisations.

The Oil & Gas Roundtable now supports a number of Working Groups, each with specific terms of reference to address recommendations of the original Roadmap designed to foster an efficient, safe and environmentally friendly oil and gas industry in South Australia including:

Working Group 4 – Maintenance of safe and sustainable transport and reduced red tape

Although originally established to deal with minimising imposts and streamlining the physical transport of equipment sourced from off-shore suppliers from "wharf-to-well", its intent is to ensure the local oil and gas industry can benefit from off-shore supplier fit-for-purpose specialist equipment and services.

In the context of the State government supported Roundtable for Oil & Gas, the Department of State Development through the Energy Resources Division has engaged with stakeholders including supply chain companies to discuss any perceived imposts or opportunities for improved efficiencies and/or cost savings associated with supply of imported equipment.

Through this consultation the following feedback has been received from a number of Oil & Gas producers and suppliers of foreign, (North American/Canadian), packaged equipment[1] with particular reference to the supply of Gas Driven Gas Compression equipment:

- The compliance obligations under AS 3814 for Type B appliances, which in Australia includes stationary gas engines and gas turbines, seem excessive when compared to commonly accepted North American/Canadian machine configurations. It has been raised whether this is a question of interpretation of the "letter of the Standard" versus compliance with the safety/reliability outcomes which form the intent of the Standard.
- Onerous compliance requirements for electrical equipment and associated installations within Hazardous Areas resulting from flammable gas atmospheres as detailed by the AS60079 series of standards.
- Confusion with respect to high levels of redundancy and integrity level requirements and whether these are being driven by the Standards themselves or by internal company requirements.

The following report seeks to clarify the above points and provide guidance on ways forward for foreign equipment suppliers selling equipment into Australia.

[1] SAGE Energy Corporation is one such supplier that has engaged with direct consultation with DSD-Energy Resources Division

3 OVERVIEW OF APPLICABLE AUSTRALIAN STANDARDS

3.1 APPLICABLE STANDARDS

The scope of this report focusses on the following specific Australian Standards:

AS 3814:2015	Industrial and commercial gas-fired appliances	The objective of this standard is to provide uniform minimum requirements for the safe operation of gas-fired industrial appliances and other large appliances used for commercial applications.
AS/NZS 5601.1:2013	Gas Installations Part 1–General requirements	The objective of this Standard is to provide essential requirements and “deemed-to-comply” solutions, and to promote uniform standards with respect to gas installations.
AS/NZS 60079 Series	Explosive atmospheres	This series of standards covers requirements for electrical equipment installed in Explosive atmospheres. The various parts of the Standard cover specific aspects of dealing with explosive atmospheres caused by flammable gases. Key relevant parts of the standard and their scope are detailed following.
AS/NZS 60079.10.1:2009	Part 10.1: Classification of areas – Explosive gas atmospheres	The objective of this standard is to set out requirements for the classification of areas where flammable gas or vapour risks might arise, in order to permit the proper selection and installation of equipment for use in such hazardous areas.
AS/NZS 60079.14:2009	Part 14: Electrical installations design, selection and erection	The objective of this standard is to set out requirements for the design, selection and erection of electrical installations in hazardous areas associated with explosive gas atmospheres; these requirements are in addition to the requirements for electrical installations in non-hazardous areas.
AS/NZS 3000:2007	The Wiring Rules	This standard sets out the requirements for the design, construction and verification of electrical installations, including the selection and installation of electrical equipment forming part of such electrical installations.

The following standards are also applicable being referenced by the above standards for specific applications.

AS 61508 Ed2	Functional safety of electrical/electronic/programmable electronic safety-related systems	A seven part standard, the objective of which is to provide the requirements for evaluation of the integrity requirements of safety-related control and/or protective instrumented systems and the minimum requirements for design, implementation, maintenance, verification and validation of such systems as part of an entire safety-lifecycle.
AS/IEC61511:2004 Reconfirmed 2015	Functional safety – Safety instrumented systems for the process industry sector	A three part standard, the objective of which is to provide the requirements for evaluation of the integrity requirements of safety-related control and/or protective instrumented systems and the minimum requirements for design, implementation, maintenance, verification and validation of such systems as per the umbrella standard AS/IEC 61508 but tailored specifically for the process industries sector.

The key requirements and applicability of the above standards in the context of stationary gas engines and turbines are detailed in subsequent sections.

3.2 AUSTRALIAN LEGISLATIVE CONTEXT

The roles of Acts of Parliament, Regulations, Codes of Practice and Standards under Australian law are represented diagrammatically in Figure 3.1 below.

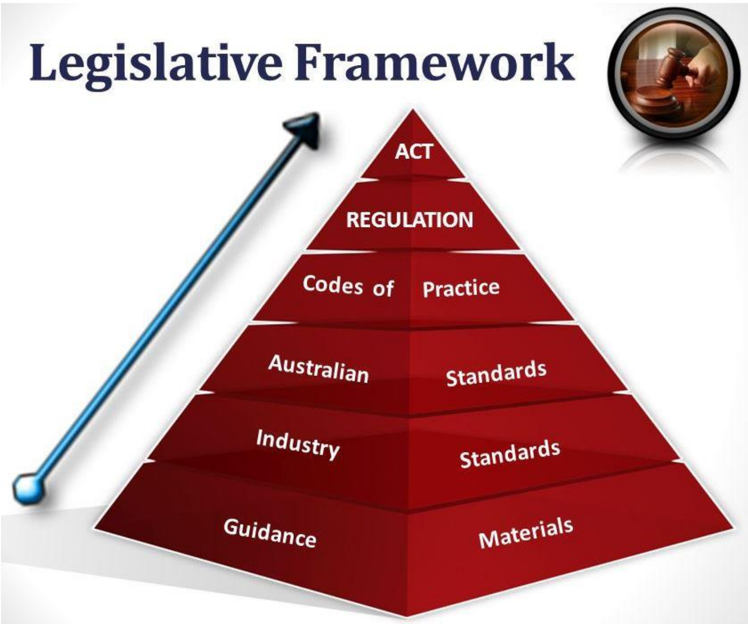


Figure 3.1 – Australian Legislative Framework

In Figure 3.1, Acts and Regulations are to be treated as mandatory, legally enforceable requirements. Codes of Practice and Australian Standards provide guidance on ways to achieve compliance with the Acts and regulations, with industry standards and other guidance material to be treated as advisory only.

In some cases Australian Standards are directly referenced via an Act or subordinate legislation in the form of Regulations associated with an Act, and in this case the Standards become legally enforceable. This is true of a number of standards applicable in this context.

Acts may be federal or state based. With respect to the equipment considered under this report, the relevant Acts form part of State or Territory Legislation.

As such the specific requirements may differ depending on which state or territory has jurisdiction over the final place of installation for the equipment.

Acts and associated regulations applying to gas driven compression equipment in the state of South Australia are detailed below.

South Australian Gas Act 1997	An Act to regulate the gas supply industry; to make provision for safety and technical standards for gas infrastructure, installations and fitting work.
South Australian Gas Regulations 2012	Regulations legislated under the Gas Act 1997 under the provision of Clause 95 – Regulations.
South Australian Electricity Act 1996	An Act to regulate the electricity supply industry and to make provision for safety and technical standards for electrical installations.
South Australian Electricity (General) Regulations 2012	Regulations legislated under the Electricity Act 1996 under the provision of Clause 98 – Regulations.
South Australian Petroleum and Geothermal Energy Act 2000.	An Act to regulate exploration for, and the recovery or commercial utilisation of, petroleum and certain other resources.
South Australian Petroleum and Geothermal Energy Regulations 2013.	Regulations legislated under the Petroleum and Geothermal Energy Act 2000.

Although not discussed in detail in this report, the requirements are similar in most States of Australia with each State having the equivalent of an “Electrical Safety Act” and a “Gas Safety Act”. Appendix 1 includes a cross reference of applicable Acts and Regulations for each of the States of Australia.

Specific industries and applications may attract their own Acts, such as “Petroleum Acts” in most states.

In this context however, although the responsibility for enforcement may vary from state to state, GPA is not aware of any specific complete dispensation in relation to the requirements discussed in this report due to overlap with other industry specific legislation. However state regulators may and do interpret the requirements for compliance with legislation differently in some cases and these are discussed where applicable in this report.

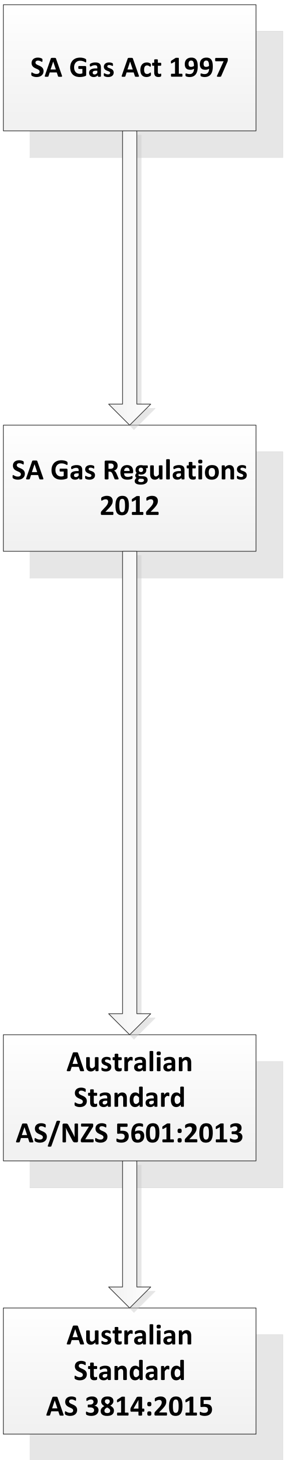
3.3 AS3814:2015 OVERVIEW

3.3.1 Legislative Requirements

This is the Australian Standard for Industrial and commercial gas-fired appliances.

It is linked to the Gas Act 1997 via the path depicted in Figure 3.2 below. The Office of the Technical Regulator, OTR, has quoted provisions under the South Australian Petroleum and Geothermal Energy Act 2000 and associated South Australian Petroleum and Geothermal Energy Regulations 2013 to allow certain exemptions for the formal approval of Type B appliances installed at facilities operating under these acts as discussed in Section 3.3.2.

The Standard was revised in 2015 and a specific update relates to recognising the special case of stationary gas engines. This update clarifies many of the uncertainties of the standard’s applicability to stationary engines and is discussed in subsequent sections of this report.



Gas Act 1997 Clause 95—Regulations

(1) The Governor may make such regulations as are contemplated by, or necessary or expedient for the purposes of, this Act.

(2) Without limiting subsection (1), the regulations may deal with the following matters:

...

(b) the construction, installation and positioning of gas infrastructure and gas installations; and

(c) technical, operational and safety requirements and standards and monitoring and enforcing compliance with the prescribed requirements and standards;

And ...

(h) the exemption (conditionally or unconditionally) of persons, things or operations from the application of this Act or specified provisions of this Act;

Gas Regulations 2012
Part 9—Safety and technical issues
Division 1—Safety and technical requirements
37—General requirements for gas infrastructure or installation

(1) For the purposes of section 55 of the Act—

(a) gas infrastructure must be designed, installed, operated and maintained to be safe for the gas service conditions and the physical environment in which it will operate and so as to comply with any applicable requirements of AS/NZS 4645, AS/NZS 1596 and AS 2885 or achieve, to the satisfaction of the Technical Regulator, the same or better safety and technical outcomes;

and

(b) a gas installation must be designed, installed, operated and maintained to be safe for the gas service conditions and the physical environment in which it will operate and so as to comply with any applicable requirements of—

(i) in the case of a liquefied petroleum gas installation—AS/NZS 5601 and AS/NZS 1596;

(ii) in any other case—AS/NZS 5601.

AS/NZS 5601:2013

1.8.2.2 *Type B Appliance*

An appliance with a gas consumption in excess of 10MJ/h, for which a certification scheme does not exist (applicable in Australia Only).

6.1.2 Australian requirements

Type B appliances shall conform to the requirements of AS 3814 <u>and</u> be acceptable to the Technical Regulator.

AS3814:2015
1.1 SCOPE
1.1.1 General

This Standard provides minimum requirements for the design, construction and safe operation of Type B appliances that use any gas as a gaseous fuel to produce flame, heat, light, power or special atmosphere in any combination of these gases either together or with other fuels.

Construction requirements given relate only to matters affecting gas-firing or to any interconnection between the gas-firing system and the safety requirements of the appliance.

1.2 APPLICATION
1.2.1 General

The requirements of this Standard shall be used in conjunction with, but do not take precedence over, the requirements of the technical regulator. <u>The technical regulator determines the extent of application of this Standard</u>.

Figure 3.2 AS 3814 Legislative Context

3.3.2 Requirements for OTR Approvals

In addition to equipment being designed, installed and operated in accordance with the requirements of AS3814, in general there is a need for the particular installation to be approved and certified as compliant with AS 3814 and AS/NZS 5601 prior to placing the equipment in commercial operation.

Varying from state to state however, there are situations where a gas appliance, including a turbine or stationary gas engine may not require formal Type B approvals.

Requirements for formal approvals based on the installation details and state or territory where the equipment is to be installed are also summarised in Appendix 1.

In the specific case of South Australia the following general guidelines are provided by the Office of the Technical Regulator, OTR:

- Where a gas appliance is being connected as part of a “consumer installation” or being connected to gas “network infrastructure” as defined by the Gas Act 1997, formal certification by a recognised approval agent is required.
- The South Australian OTR has advised that they interpret that there is no legal requirement in the Gas Act 1997 for Type B appliances which include gas engines for generator sets, compressors, hot water bath heaters for gas conditioning etc. to be Type B certified when they form part of a system for the transmission of Natural Gas as covered by the Petroleum and Geothermal Energy Act 2000.

However it should be noted that the above interpretation relevant to the corresponding Acts in the states of Western Australia, Tasmania, Victoria and Queensland does not apply and Type B certification is a definite requirement in these states. For NSW and the Northern Territory it is recommended specific direction is obtained from the technical regulators in those states with respect to formal certification.

Irrespective of the above, under the Work Health and Safety Act there are specific obligations for stakeholders to demonstrate a safe working environment, “safety in design” and “duty of care” with respect to all their operations. As such many organisations have voluntarily required all equipment to comply with AS 3814 and in some cases embarked on voluntary independent assessment and verification of Type B appliances to AS 3814.

GPA’s recommendation as a recognised consultant to the petroleum industry in Australia is that all gas appliances, irrespective of the state or territory in which they are to be installed should be specified as requiring demonstrated compliance with AS 3814. The need to additionally obtain approval and formal certification can be determined on an application specific basis, in accordance with local territory legislation.

3.3.3 Specific Requirements for Gas Engines and Turbines

AS 3814 has undergone a number of revisions in recent years. In the *Preface* to the current 2015 edition key updates have been summarised and this appears below for information.

A key update incorporated in the 2015 version is the clear placement of responsibility for the safety of an appliance with the OEM, and increased emphasis and guidance on risk assessment requirements with additional specific directions with respect to stationary gas engines and turbines.

> *This Standard has been further revised to remove ambiguities and to place the responsibility for safety of gas-fired industrial appliances, and other large appliances used for industrial and commercial applications firmly on the original equipment manufacturer. To this end the original equipment manufacturer has been given a wide definition in this revision.*

The main features of this revision are the following:

(1) The requirements for hazard and risk assessment have been expanded in line with international practice, including a new informative Appendix K as well as a list of significant hazards covered by this Standard in new informative Appendix M.

(2) The section on programmable electronic systems has been extensively revised to align it more appropriately with AS 61508 the related application Standards, AS IEC 61511 and AS 62061.

(3) An informative Appendix N on the guidance for verifying that an appliance meets the safety requirements and/or measures in accordance with this Standard.

(4) Included is an informative Appendix L for the review of PES designs by way of a checklist.

(5) The robust nature of gas engines has been reflected in the revision of Section 5.8 and the uncertainties relating to applicability of many other sections of this Standard to gas engines have been removed.

(6) In line with other international standards, the concept of a gas turbine purge credit has been introduced to enable designers and operators to establish and maintain a 'purged' condition for heat recovery steam generators (HRSGs) for an extended period of time between restarts.

The detailed requirements for stationary gas engines and turbines have been recognised in Section 5.8 of the Standard.

3.3.3.1 SPECIFIC FOREIGN STANDARDS COMPLIANCE ACCEPTANCE

The AS3814 Standard does accept compliance to foreign standards as meeting the intent of the Australian Standard for the following specific cases:

AS3814 Clause 5.8.1:

*……..Gas fired turbines that comply with the requirements of **AS/ISO 21789** meet the intent of this standard………*

*……..Gas engine and microturbine packages labelled **up to 5GJ/h** that comply with **ANSI/UL 2200** are deemed to comply with the following specific clauses of the standard………*

Clause 2.27.5	*(Separated basic control systems and safety instrumented systems using a PES)*
Clause 5.8.2.3	*(Safety shut-off valves and vent valves)*
Clause 5.8.3.2	*(Gas engine purging)*
Clause 5.8.3.4	*(Air flow proving)*
Clause 5.8.4 to 5.8.6	*(Flexible connects and exhaust system requirements)*
Clause 5.8.10	*(Ignition requirements)*
Clause 5.8.14	*(Overspeed)*
Clause 5.8.15	*(Gas engine and gas turbine air/fuel ratio control)*

For all other cases and in all other respects AS3814 is deemed to be directly applicable to stationary gas engines and turbines. Specific Australian Standard requirements that typically cause issues for foreign OEMs and packagers are discussed in subsequent sections.

3.3.3.2 *USE OF PROGRAMMABLE ELECTRONIC CONTROLS*

Clause 2.27 of AS3814 covers "Appliance Controls and Safety Instrumented Systems" and introduces the following concepts and terms:

PES Programmable electronic system

SIL Safety Integrity Level as determined via functional safety standards AS 61508, AS/IEC 61511 or AS/IEC 62601. SIL for stationary gas engines and turbines range from SIL1 to SIL3 (lower to higher integrity).

This clause aligns safety related control elements of a gas driven engine or turbine with international standards covering controls and protection functions in safety applications, recognising that most modern control systems employ programmable logic controllers, PLCs, or similar configurable devices.

The functional safety standards listed all require as a first step a hazard analysis phase. Where the hazards associated with operation of the equipment are identified, functions proposed to mitigate or prevent the hazardous events from arising are required to be detailed and assigned a SIL which specifies the integrity requirements of the functions.

The outcomes of the hazard analysis phase are a list of identified hazards, a list of specific safety functions to be included in the control system for the appliance and assigned SIL for the functions.

For all functions deemed warranting a SIL allocation of SIL1, SIL2 or SIL3, the implementation of the functions shall be in full accordance with the selected functional safety standard. The safety standards place constraints on fault tolerance, redundancy and general lifecycle requirements which are more onerous as the SIL increases from SIL1 to SIL3.

The specific documentation requirements for Type B appliances are summarised in Clause 2.27.6, which include the requirements for formal risk assessment reports, SIL assignment reports and specific specification, verification and validation reports for safety-related control elements.

It should be noted that this requirement for compliance with the Australian functional safety standards is consistent with international trends calling for tighter control of safety-related control systems and that the Australian versions of the stated standards are directly aligned with the corresponding IEC international functional safety standards.

AS3814 does include some concessions for OEM's with respect to gas engines as follows:

2.27.5.2 (e) NOTES:

1. Gas engines with an OEM PES are not required to have a safety integrity of greater than equal to SIL1 except where—

(a) specified otherwise by the OEM or the owner/operator;

(b) identified by a risk assessment;

(c) the engine is part of a combined heat and power generation system and has heat exchangers in the exhaust or long exhausts that are not explosion proof; or

(d) the inlet and exhaust manifolds and exhaust pipes are not strong enough to withstand a gas explosion.

The above clause basically provides guidance that the expected SIL for a gas engine, due to its construction, is not expected to be greater than SIL1. However the wording of the clause still suggests some form of risk assessment should be undertaken to ensure it should not be greater.

2.27.5.1 General:

Control systems on OEM gas engines not exceeding 5GJ/h are deemed to comply with Clauses 2.27.5 and 2.27.6 (Requirements for safety Instrumented Systems and Documentation) provided that it can be established that they are —

(a) Gas engine generator packages certified and labelled to ANSI/UL 2200 and ANSI/UL 6200 (Outline of investigation for Controls for Stationary Engine Driven Assemblies);

(b) Gas engine generator packages certified and labelled to ISO 8528-4;

(c) Independently assessed by a competent person to demonstrate the gas engine driven assembly controls are compliant with the relevant gas engine parts of ANSI/UL 2200 and ANSI/UL 6200 or ISO 8528-4; or

(d) Proven in use as fit for purpose.

NOTE: For gas engine generator packages, the certification to ANSI/UL 2200 and ANSI/UL 6200 applies only to the package certified by the certification body. External and additional components, specified restrictions, a high risk location or site hazards can void the acceptance of the certification.

The exemption for generator packages is provided to allow use of standard power generation systems up to a specified size.

For a typical gas engine driven, field wellhead screw compressor, as used in the South Australian Cooper Basin, the maximum fuel demand rate is typically 2-3 GJ/h and hence these smaller units may fall under this clause although the UL and ISO standards quoted are more applicable to packaged generator sets rather than general gas engine driven equipment. Larger fixed installation compressors installed in the Cooper Basin have maximum fuel consumptions typically in excess of the 5GJ/h threshold.

Gas turbines fully compliant with AS/ISO 21789 are also deemed compliant with the intent of the specific requirements under AS3814 for safety instrumented systems.

3.3.3.3 AS3814 Requirements for Fuel Safety Shut-off

An area which often leads to questions of compliance for foreign manufactured equipment is the arrangement of fuel safety shut-off devices for gas engines and turbines.

The requirements for safety shut-off valve systems for gas engines and turbines are detailed in Clause 5.8.2 of AS 3814.

Basically a double block valve arrangement will always be required with a double block and vent arrangement required for engines with maximum fuel demands in excess of 5GJ/h.

The standard requires valves to be compliant with AS4629 or AS4983 for engines and AS4629 for gas turbines. This is often an issue for foreign equipment with valves typically certified to alternative standards. However the standard specifically allows valves to other standards to be used provided the OEM is prepared to document a case for the valves being “proven in use” and makes a declaration that they are fit for purpose.

In GPA’s experience high pressure valves typically encountered in the petroleum industry often exceed the AGA requirements for burner valves and this OEM declaration is a straight forward matter.

It should be noted that the location and configuration of fuel gas safety shut-off valves for equipment installed within enclosures or buildings has a bearing on compliance with AS60079 hazardous area requirements. Basically location of the double block valves external to the enclosure or building is recommended to reduce the hazardous area zonal classification within the enclosed space as discussed further in Section 3.5.

3.3.3.4 AS3814 Main Gas Train Configuration and Specifications

Clause 2.9 of AS3814 specifies requirements for gas pipework and valve trains whilst Clause 2.10, 2.11 and 2.12 provide gas pressure regulation and over-pressure and low pressure protection requirements.

Issues impacting foreign equipment suppliers often include;

- Pipework design standard nominated as AS/NZS 5601.1.
  This design standard covers systems with maximum operating pressures generally below 200kPag. Often in the petroleum industries supply pressures are well in excess of this and the applicable Australian Standard is AS 4041. It should be noted that design to ANSI B31.3 is generally accepted in Australia and provided this is noted in the design information there should be no issue with acceptance.
- The standard requires piping and valve train components must be rated in pressure to not less than the maximum design inlet pressure of the next upstream regulator or above the setting of any over-pressure protection system fitted to the next upstream pressure regulator. This simply is good design in ensuring adequate pressure rating of all gas train devices to contain any gas in the event of a failure of an upstream regulator. This should not pose any issue to foreign systems provided they are adequately designed.

In general compliance with gas train requirements should not be a significant issue. The standard allows OEMs to justify departures from the standard to accommodate their standard designs provided the OEM can demonstrate that the intent of AS3814 is met by their OEM design. If AGA approved valves cannot be readily sourced for example, API 6D valves provide an alternative design standard which is easily demonstrable to be of equivalent safety and “proven-in-use”.

3.3.3.5 Requirements for Engine or Turbine Pre-Purge

Prior to the ignition of fuel in a combustion chamber, purge requirements shall be met.

Purging of engines and turbines is covered in AS3814 Clause 5.8.3.

The 2015 edition of the Standard has acknowledges the special requirements for gas turbine and gas engine purging in Clauses 5.8.3.1 and 5.8.3.2 respectively.

These clauses should make the satisfying of purge requirements by OEM turbine and engine manufacturers relatively straight forward and distinct from the requirements for general gas fired appliance purging.

Specifically the standard does not require specific purging of a gas engine provided the exhaust system and any heat recovery system in the exhaust is:

a) Sufficiently strong to withstand an explosion

b) Fitted with explosion relief; or

c) Contained within an enclosure or screen so that any debris resulting from an explosion will be contained.

GPA's experience is that if the exhaust is not sufficiently pressure rated, vendors often have a guarding option for the exhaust that can provide mechanical protection satisfying option c) above.

If the above cannot be satisfied it is also allowable to accept an extended cranking time prior to ignition to satisfy the purge although for start gas systems with limited capacity this can be an issue.

3.3.3.6 Requirements for Formal Risk Assessment

The main issue confronting foreign equipment manufacturers and packagers is the requirement in AS3814 for a formal risk assessment and the linking of this risk assessment with AS61508/61511 or AS62601 and Safety Integrity level, SIL, determinations for safety related functions.

The general requirements for risk assessments are covered in Clauses 2.1.1.1 and 2.1.1.2 of the Standard.

The risk assessment should address the compliance with the Standard and further cross-referenced general appliance standard AS1375.

GPA believes a documented risk assessment that includes a record of deviations from the Australian standards provides a key document which can form part of a Type B appliance registration submission to the OTR for approval if required.

Although the final asset owner is responsible for undertaking site specific risk assessments for equipment installed in final locations, GPA believes that an OEM can provide a generic risk assessment for a particular compression package and, provided the package does not vary significantly from unit to unit, the single risk assessment should satisfy what is required of the OEM for the supply of multiple units.

As such this becomes a "once-off" exercise which is considered industry best-practice in any event and should not place an unreasonable impost on foreign suppliers to the Australian market.

The specific OEM risk assessment requirements are articulated in Clause 2.1.1.2 (a) Note 3 as:

3 *Type B appliance OEM and installer should supply information to the organization or person in control of the Type B appliance on the hazards, consequences and level of risks. This should include the levels of residual risks associated with their Type B appliance and installation, where installed to their instructions. This is so that the organization or person in control of the Type B appliance can take additional mitigation action as necessary when assessing the specific site hazards and risks associated with the installation and its operation.*

It should also be noted that Occupational Health and Safety legislation throughout all states of Australia contains requirements to ensure the safety of personnel and concepts such as demonstrating "Safety-in-Design", SID, are being enforced more stringently throughout Australia. To this end a documented OEM risk assessment becomes a key component of satisfying this requirement irrespective of the specific risk assessment requirements of AS3814.

3.3.3.7 AS3814 General Requirements for Compliance

The Standard itself states that:

> ***1.2 APPLICATION***
>
> ***1.2.1 General***
>
> *The requirements of this Standard shall be used in conjunction with, but do not take precedence over, the requirements of the technical regulator. <u>The technical regulator determines the extent of application of this Standard.</u>*

The above is very clear that where approval from the Technical Regulator is required prior to the installation or commissioning of an appliance, it is the representative from the OTR that must determine the acceptability of the appliance for compliance with this standard.

The above recognises that some equipment may not meet all the detailed requirements in the Standard but provided the technical regulator is satisfied that the final installation delivers an equivalent level of safety than what is provided by stringent adherence to the standard, then it may be accepted.

The standard further states:

> *Alternative national and international Standards might provide more appropriate safety outcomes in certain specific circumstances and might be deemed to comply with this Standard. This is provided the original equipment manufacturer or installer has written evidence showing the level of risk for the activity or thing to which the safety requirement applies is equal to or less than the level of risk that would be achieved by complying with the requirements of this Standard. This written evidence shall demonstrate that the fundamental safety requirements of this Standard have been satisfied or exceeded. An original equipment manufacturer's or installer's report detailing this evidence and clearly identifying and recording departures from this Standard should be provided as part of the gas installation documentation.*

Further Clause 1.2.7 deals with non-compliance with the standard as follows:

> ***1.2.7 Non-compliance with requirements in this Standard.***
>
> *Any new, novel or alternative materials, designs, methods of assembly, procedures, etc., which do not comply with a specific requirement of this Standard, or are not mentioned in it <u>but give equivalent results to those specified,</u> are not necessarily prohibited. Such non-compliance can comply with the safety requirement without complying with the requirements of this Standard if the designer has written evidence showing that the level of risk for the activity or thing to which the safety requirement applies is equal to or less than the level of risk that would be achieved by complying with the requirements of this Standard.*

In summary provided a written case is made, supported by risk assessment, that the foreign equipment supplied provides an equivalent level of safety and risk to that if it were fully compliant, the standard allows flexibility in its approval. Acceptance of equipment to foreign standards is reliant on a documented case being presented to the technical regulator. For an OEM supplying packaged equipment, this case can be documented <u>once</u> and submitted for each equipment package provided they are equivalent.

3.4 AS/NZS 60079 SERIES LEGISLATIVE REQUIREMENTS

This is the Australian Standard Series for design, selection, installation and marking of electrical equipment to be installed in explosives atmospheres resulting from the release of flammable gas or vapours.

It is linked to both the South Australian Electricity Act 1996 and the South Australian Electricity (General) Regulations 2012 via the path depicted in Figure 3.3 below.

The series of standards is directly aligned with the equivalent international IEC series standards which are in turn closely aligned with the Euronorm, EN, standards used throughout Europe.

Relationship to North American and Canadian standards is discussed in Section 5

The various parts of the standard deal with detailed requirements for marking, design, testing etc. for electrical equipment seeking specific certification in hazardous areas. These aspects shall not be discussed in detail in this report.

This report shall focus on the end-user requirements with respect to hazardous area equipment which focuses on two specific parts of the Standard:

AS/NZS 60079.10.1:2009	Explosive atmospheres Part 10.1: Classification of areas – Explosive gas atmospheres
AS/NZS 60079.14:2009	Explosive atmospheres Part 14: Electrical installations design, selection and erection.

Through the path indicated in Figure 3.3 the above standards form legal requirements which are enforced throughout all states of Australia.

The standards have implications for foreign imported equipment that has not been certified or installed in accordance with IEC and/or Euronorm EN standards. It is important to note these Australian standards are closely aligned with international standards but are not aligned with specific options available under North American and/or Canadian legislation and standards pertaining to hazardous areas.

There are fundamental differences in the classification of hazardous areas and equipment certifications for North American/Canadian equipment when compared with Australian and European requirements which are discussed further in Section 5.

SA Electricity Act 1996

Electricity Act 1996

Clause 98—Regulations

(1) The Governor may make such regulations as are contemplated by, or necessary or expedient for the purposes of, this Act.

Clause 60—Responsibility of owner or operator of infrastructure or installation

(1) A person who owns or operates electricity infrastructure or an electrical installation must take reasonable steps to ensure that—
  (a) the infrastructure or installation complies with, and is operated in accordance with, technical and safety requirements imposed under the regulations; and
  (b) the infrastructure or installation is safe and safely operated.

(2) For the purpose of ensuring under this section that an electrical installation complies with the technical and safety requirements and is safe, a person may, subject to the regulations, rely on a certificate of compliance issued under this Part in relation to the installation.

Clause 61—Electrical installation work

(1) A person to whom this subsection applies who carries out work on an electrical installation or proposed electrical installation must ensure that—
  (a) the work is carried out as required under the regulations; and
  (b) examinations and tests are carried out as required under the regulations; and
  (c) the requirements of the regulations as to notification and certificates of compliance are complied with.

SA Electricity Regulations 2012

Electricity Regulations 2012

Clause 55—General requirements for electrical installation

(1) For the purposes of section 60(1) of the Act, an electrical installation must be designed, installed, operated and maintained so as to comply with any applicable requirements of—
  (a) in all cases—AS/NZS 3000 and any Australian Standard or Australian/New Zealand Standard called up by AS/NZS 3000; and
  (b) if the installation is, or is to be, connected to a distribution network—the technical installation rules of the operator of the network.

(2) A certificate of compliance issued for the purposes of section 60(2) of the Act may only be relied upon if the certificate of compliance—
  (a) certifies that the electrical installation to which the certificate relates complies with any applicable requirements set out in AS/NZS 3000 and any Australian Standard or Australian/New Zealand Standard called up by AS/NZS 3000; and
  (b) is issued by a registered electrical worker

Australian Standard AS/NZS 3000:2007

AS/NZS 3000:2007 The Wiring Rules

7.7 HAZARDOUS AREAS (EXPLOSIVE GAS OR COMBUSTIBLEDUSTS)

7.7.1 Scope

The particular requirements of this Clause 7.7 apply to the selection of electrical equipment and its installation to ensure safe use in areas where flammable or combustible materials are produced, prepared, processed, handled, stored or otherwise exist, and therefore may give rise to an explosive atmosphere.

7.7.2 Classification of hazardous areas

7.7.2.1 Responsibility for classification

The responsibility for classification of a hazardous area rests with the persons or parties in control of the installation. The requirements are contained in AS/NZS 60079.10.1 for gas or vapour and AS/NZS 60079.10.2 for combustible dust.

7.7.2.4 Electrical equipment

7.7.2.4.1 Selection

Electrical equipment selected for use in hazardous areas shall comply with the appropriate requirements as specified in AS/NZS 60079.14.

7.7.2.4.2 Installation

Electrical equipment shall be installed in accordance with the installation requirements of AS/NZS 60079.14.

Australian Standard AS 60079.10.1:2009

AS60079.10.1:2009 Classification of Hazardous Areas

This standard provides the means of classifying hazardous areas and uses the European approach of designating areas as either Zone 0, Zone 1 or Zone 2.

Australian Standard AS 60079.14:2009

AS60079.14:2009 Design, selection and installation of electrical equipment

This standard defines the requirements for design, selection and installation of electrical equipment in hazardous areas. It further lays out the documentation requirements for a hazardous area installation and the certification requirements for the equipment.

Figure 3.3 – AS 60079 Legislative Context

3.5 AS/NZS 60079:10 OVERVIEW

Prior to designing or undertaking selection and fabrication of an electrical installation in a hazardous area, there is a requirement to determine the extent and nature of hazardous zones that may apply.

AS/NZS 60079:10 provides the methods and definitions for use in the classifications of hazardous areas. The Standard also includes requirements for documentation supporting the hazardous area classification.

The Australian standard is closely aligned with international IEC and Euronorm standards and defines hazardous areas in terms of Zones based on the frequency and likelihood of a flammable atmosphere being present in the area. Zones are defined as follows:

Zone 0	An area in which an explosive gas atmosphere is present continuously or for long periods or frequently
Zone 1	An area in which an explosive gas atmosphere is likely to occur in normal operation occasionally
Zone 2	An area in which an explosive gas atmosphere is not likely to occur in normal operation but, if it does occur, it will exist for a short period only.

The standard includes various methodologies for then assessing the zonal classifications as detailed above and the extent of the zones based on numerous factors including; the properties of the flammable fluid, the dispersion of vapour in the event of a release based on containment pressure, hole size etc. and the effects of ventilation and ambient conditions.

Based on the zonal classifications, electrical equipment and the requirements for the installation of the equipment can then be determined as detailed in AS/NZS 60079:14 based on the “protection technique” selected.

An alternative classification scheme was widely adopted in North America and Canada until migration to the IEC zonal classification system was introduced in the late 1990s. This scheme involved classifying hazardous areas as follows:

Division 1	Locations in which explosive gas atmospheres are likely to be present continuously, intermittently, or periodically during normal operation.
Division 2	Locations in which explosive gas atmospheres are not likely to occur in normal operation and if they occur will exist for a short time only or The location is adjacent to a Class 1 Division 1 location from which explosive gas atmospheres could be communicated.

As detailed above there has been a move away from this system of classification over recent years to allow alignment with the IEC standards but some foreign equipment is still supplied based on the Division based classification system. This is discussed further in Section 5.1.

3.6 AS/NZS 60079:14 OVERVIEW

This standard details the requirements for the design, selection and erection of electrical installations in hazardous areas associated with explosive atmospheres.

There are three specific aspects of this part of the Standard that are relevant specifically to foreign equipment suppliers and these relate to the certification of equipment to other than Australian standards, the competency requirements for tradespersons undertaking electrical installation works and inspection and testing of hazardous area installations and the documentation requirements for hazardous area electrical installations.

3.6.1 Equipment Certification

Clause 4.3 covers the certification of equipment as follows:

4.3 Assurance of conformity of equipment

4.3.1 Equipment with certificates according to IEC standards or AS/NZS Standards

Equipment with acceptable certification according to hazardous areas Standards published as AS/NZS Standards, IEC Standards or AS Standards …. is acceptable when selected and installed in accordance with this Standard.

Acceptable certification of equipment shall be covered by a Certificate of Conformity which:-

(a) Is issued in accordance with a Type 5 Scheme complying with ISO/IEC Guide 67; and

(b) is issued by a body operating within the IECEx Scheme or the ANZEx Scheme or by a certification body with accreditation by JAS-ANZ or an organization that has a Mutual Recognition Agreement (MRA) with JAS-ANZ covering Product Certification of Explosion Protected Equipment; and

(c) Certification shall be issued by a Certification Body or agency with current accreditation or acceptance by way of independent assessment complying with ISO/IEC Guide 65. The accreditation or acceptance shall show Ex certification for an ISO Type 5 system in the Ex field, as part of their capability; and

(d) The certification system shall also require—

  (i) Testing of samples for compliance with relevant IEC Standards or Australian Standards;

  (ii) Assessment and audit of manufacturers by the Certification body, for compliance of their quality system according to ANZEx or IECEx requirements or equivalent; and

  (iii) on-going surveillance audits of manufacturers, in accordance with ANZEx or IECEx quality requirements or equivalent, by the Certification body, responsible for issuing the Certificate. This does not preclude the Certification Body arranging to have surveillance audits conducted by another body operating as their agent.

Equipment certified under the IECEx Scheme and registered on the IECEx database or the ANZEx Scheme registered on the ANZEx database meets these criteria. Equipment certified under the AUSEx Scheme is acceptable when manufactured within the certificate validity period.

4.3.2 Equipment without certificates according to IEC Standards or AS/NZS Standards

Apart from simple apparatus used within an intrinsically safe circuit, the selection of equipment for use in a hazardous area, which has a certification that is not in accordance with 4.3.1, shall be restricted to circumstances where suitable equipment with certification in accordance with 4.3.1 is not practically obtainable. The justification for the use of such equipment along with the selection, installation, and marking, inspection, maintenance and repair and overhaul requirements shall be made by the person(s) in control of the installation using a competent body.

> The justification shall be included as part of the verification dossier. Justification may be demonstrated in the form of a Conformity Assessment Document. Guidance for the preparation of a Conformity Assessment Document can be found in Annex ZD.

The Australian requirements of the standard are very prescriptive in relation to acceptable certifications for electrical equipment. In short they shall be IEC certified to an IECEx Scheme unless obtaining suitable equipment certified to this standard is not practically obtainable.

On face value this is difficult to justify as for commonly used process instrumentation as IEC certified versions are often easily obtainable provided this requirement is included on order. Specialist engine sensors and ignition system components however may not be readily available and in these cases the Conformity Assessment Document route is the best option.

With respect to conformity assessment and an OEM GPA believes the following is acceptable:

Although the Standard requires unique conformity assessments based on specific applications, in the case of packaged equipment which is of a standard reproducible design that is repeatedly installed in typical operating environments, it is acceptable to obtain Conformity Assessments for the standard design on a once off basis and present this for inclusion in site specific hazardous area dossiers.

It is not considered that the above is an onerous requirement if significant quantities of the packaged equipment are destined for the Australian Market.

AS/NZS 60079.14:2009 for New Zealand does directly accepted equipment certified to European Council Directive 94/9/EC (ATEX) but does not provide the conformity assessment route.

A question often raised is why Australia does not directly accept equipment certified to European ATEX standards and this is further discussed in Section 4.

3.6.2 Competency of Installers

Competency requirements for installers are defined in AS/NZS 60079 AS/NZS 60079.14:2009 and requires that personnel be formally trained for the works they are undertaking and that this training and competency must be demonstrated as follows:

"Competency may be demonstrated in accordance with AS/NZS 4761, Competencies for working with electrical equipment for hazardous areas (EEHA), or equivalent training and assessment framework"

The above does present an issue for foreign importers of equipment. Detailed close inspection of the installation by an Australian certified person with some supervision of the works would satisfy this clause provided the certified person is prepared to issue a certificate of conformance for the work and is qualified under Australian legislation to do so.

Australia has developed a large pool of suitably qualified tradespersons over recent years and this should not be an issue if foreign importers are serious about establishing manufacturing or assembly facilities either in Australia or for the Australian market.

3.6.3 Hazardous Area Documentation

Documentation requirements are detailed under Clause 4.2 of the Standard.

> **Clause 4.2 - Documentation**
>
> It is necessary to ensure that any installation complies with the appropriate certificates as well as with this Standard and any other requirements specific to the plant on which the installation takes place. To achieve this result, a verification dossier shall be prepared for every installation and shall be either kept on the premises or stored in another location. In the latter case, a document shall be left on the premises indicating who the owner or owners are and where that information is kept, so that when required, copies may be obtained.

The Standard then goes on to define the detailed requirements of what is to be included in a hazardous area verification dossier.

Supplying a dossier with a set of documentation supplied by an OEM for later inclusion into the site specific dossier should not be a major impediment to foreign suppliers.

3.7 CLASSIFICATION OF TURBINE AND ENGINE ENCLOSURES

Enclosed turbine and gas engines often pose issues for foreign suppliers due to the fact that a generalised classification under AS/NZS 60079.10.1 usually results in the entire enclosure being classified as a Zone 1 area due to restricted ventilation. Together with the fact that the equipment within the enclosure is often not certified to the IEC Ex Scheme, but rather to ATEX or North American standards, this poses a difficult scenario for obtaining full compliance with Australian hazardous area requirements.

However with respect to enclosed equipment there are provisions under AS/NZS 60079.10, that allow a first principle classification determination which may permit the engine enclosure to be considered non-hazardous on the basis of ventilation and low risk of fugitive emissions.

It is generally acknowledged that there are no directly applicable “specific occupancies”, (Typical zonal classifications for different scenarios contained in Annex ZA of AS60079.10), that cover gas turbine or engine enclosures within AS/NZS 60079.10.1:2009 and as such a first principle approach is required in the hazardous area classification of these enclosures.

The approach GPA has previously utilised follows the general steps outlined in AS/NZS 60079.10.1:2009 Figure C.2 as appearing below and gives due consideration to the fact that enclosed engines and turbines often require a high degree of forced ventilation for engine cooling requirements, which often provides the additional benefit of diluting any fugitive gas emissions in the enclosure.

With reference to Figure C.2 of AS/NZS 60079.10 Annexure C, the determination of the hazardous area classification for an engine enclosure is progressed to Step 71 based on the following:

> Sources of release within the engine enclosure are deemed to all be secondary grades of release which cannot be completely eliminated.

Steps 71 and 72 of the schematic approach require that the conditions of the potential releases be evaluated and that the degree of ventilation should be considered.

AS/NZS 60079.10.1:2009 provides guidelines on the assessment of ventilation in Annex B of the standard. It should be stressed that Annex B is an “informative” section and the standard allows other means of determining the effects of dilution ventilation.

Clause B.4.1 defines a high degree of ventilation as:

> Ventilation that can reduce the concentration at the source of release virtually instantaneously, resulting in a concentration below the lower explosive limit. A zone of negligible extent results provided the availability of the ventilation is considered “good” as further discussed below.

Clause B.5.3.2 defines the basis on which a high degree of ventilation may be assigned as:

> A high degree of ventilation will normally apply when the anticipated hypothetical volume of an explosive gas atmosphere resulting from a release, V_z, is less than $0.1m^3$ or less that 1% of the effective enclosure volume Vo whichever is the smaller.

Clause B.5.2.1 defines the hypothetical volume V_z as:

> The volume over which the mean concentration of flammable gas or vapour will typically be 0.5 times the LEL, for secondary grades of release.

The calculation of V_z may then be used to assess the degree of ventilation in accordance with the criteria of B.5.3.2.

The simplified method for calculation of the degree of ventilation present in B.5.2 of the standard however often results in the hypothetical volume Vz being not negligible, greater than 1m3, and therefore the ventilation may only be considered as “medium” and not “high”. This is largely due to the simplified nature of the calculation and the required safety factors that are applied.

AS/NZS 60079.10.1:2009 B.5.2 presents an informative method only for estimation of the hypothetical volume Vz; however B5.2 states that *“… other forms of assessment, e.g. computational modelling, may also be appropriate...”*

The simplified calculation of hypothetical stoichiometric volume Vz presented in the standard is based on the following:

> AS/NZS 60079.10 Annexure B.5 is the basis for assessing the degree of ventilation.
>
> The calculation is based on the release initially going undetected and continuing at the rate assumed. This would be true for fugitive undetected emissions.
>
> The ventilation calculation assumes a typical hole size, say 1mm, in the fuel gas carrying system at the typical fuel gas delivery pressure.
>
> The persistence time,‘t’, calculated is the time after the release is stopped that the hazardous zone will persist above the LEL.
>
> The calculations themselves include a safety factor K=0.5 which essentially calculates the stoichiometric volume based on a 50% LEL volume rather than 100%. This is conservative but applied to take into account the simplicity of the calculation utilised.

The above does not take into account a number of factors which could be considered to provide an alternative classification for an enclosure.

The potential case that GPA recommends exploring, and that has been accepted by technical regulators in jurisdictions in Australia, is laid out following.

The existing installations are generally certified as Type B Appliances or are design for compliance to AS3814.

Although not directly related to hazardous area classification, a certification to Type B implies the following:

1. The appliance has been designed with piping systems to a standard that ensures a low probability of loss of containment.
2. The appliance control system will detect a loss of flame, pressure or an abnormal fuel supply condition and respond by isolation of the fuel supply within a short period to protect the appliance with a high degree of integrity. It is noted that high integrity double block and bleed valves in accordance with AS3814 are generally installed which would act rapidly to isolate any fuel leak at the flow control valves or at the fuel ring of a turbine or example, which are the more likely leakage points. The above means that any larger leaks should be detected in a short period of time and fuel isolated from the enclosure and the potential leak point with a high degree of integrity.
3. It should be further noted that the enclosure should be fitted with gas detectors that enable leaks to be detected and high integrity shutdown of gas supply to the engine/turbine to be instigated through the turbine high integrity burner management or engine control system.

The case for declassification of an engine or turbine enclosure considers all the above factors to make the following case:

> Provided there are sufficient gas detectors in the correct locations to detect a gas leak and force isolation of fuel into the enclosure prior to the hypothetical Volume Vz exceeding 0.1m3 or 1% of the volume enclosure Vo, then it may be argued that when all factors are considered including high integrity isolation of fuel supply to the enclosure on detection of a gas leak, that the resultant credible flammable gas clouds will be less than the hypothetical volume Vz as defined by AS/NZS 60079.10. As such based on the guidelines of AS/NZS 60079.10 Figure C2 the degree of ventilation can be considered "high" in the context of credible fuel leaks and that any resultant flammable gas zones can be considered as Zone 2 of Negligible Extent.

The above approach provides a pragmatic approach to engine and turbine enclosure hazardous area assessment but does require acceptance by the asset Owner and provides a first principle approach to this issue which is common for imported packaged equipment.

The above provides a framework for addressing the non-compliance issue without a major re-work of equipment in the enclosure. However the validity of the above argument will need justification by undertaking the following:

1. Detailed air flow and flammable gas cloud modelling will be required to demonstrate that for the proposed/existing gas detector locations and settings that a leak will be detected and fuel isolated prior to Vz exceeding the allowable constraint sizes for negligible extent classification. This generally is based on Computational Fluid Dynamic modelling or CFD. This modelling will need to be undertaken for all credible typical leak scenarios.
2. A risk assessment is required to confirm that the likelihood of a leak is as low as reasonable practical. The risk assessment should address the integrity of piping, equipment and fixings, the integrity of the ventilation system and the integrity of the turbine control system and gas detection safety shutdown system. This may involve SIL assessment in accordance with functional safety standards AS61511/61508.
3. Implementation of any modifications required to meet the required integrity levels or gas detection constraints.

Specific references applicable to the proposed approach which offer support to the case are listed below for additional information.

ISO 21789:2009 Gas turbine applications - Safety

5.16.5.3.3 Ventilation validation

Computational fluid dynamics (CFD) modelling or other quantifiable techniques shall be used to validate dilution ventilation in accordance with 5.16.5.3.2 to ensure adequate dilution of a leak is achieved. The modelling shall show that the leak cloud volume at the 100 % LEL contour arising from the leak that can cause a gas turbine trip based on gas detection trip settings in the ventilation outlet ducts, converted to an equivalent volume at stoichiometric concentration, shall be no larger than 0,1 % of the net volume of the enclosure. Since there is no specific numerical safety factor included within the criterion, a safety factor should be applied based on risk assessment taking the circumstances of the plant and any mitigation into account. In all cases, the gas leak rate for the purposes of CFD should be based on a hole size no smaller than 0,25 mm^2 and no larger than 25 mm^2 and the equivalent volume at stoichiometric concentration should not exceed 1 m^3. This criterion has been validated to show that, in the event of ignition, the overpressure created will not exceed 1 000 Pa (10 mbar). If the enclosure strength can be assessed to withstand an overpressure of up to 1 500 Pa (15 mbar), the criterion may be extrapolated to an envelope not exceeding 0,15 % of net volume and an overpressure of 1 500 Pa (15 mbar).

The above is consistent with AS/NZS 60079.10.

Other references include IP 15 Chapter 8 gas Turbines which state that traditional hazardous area classification may not be appropriate given the existence of hot surfaces in the turbine enclosure which always provide a source of ignition despite the control of ignition from electrical devices.

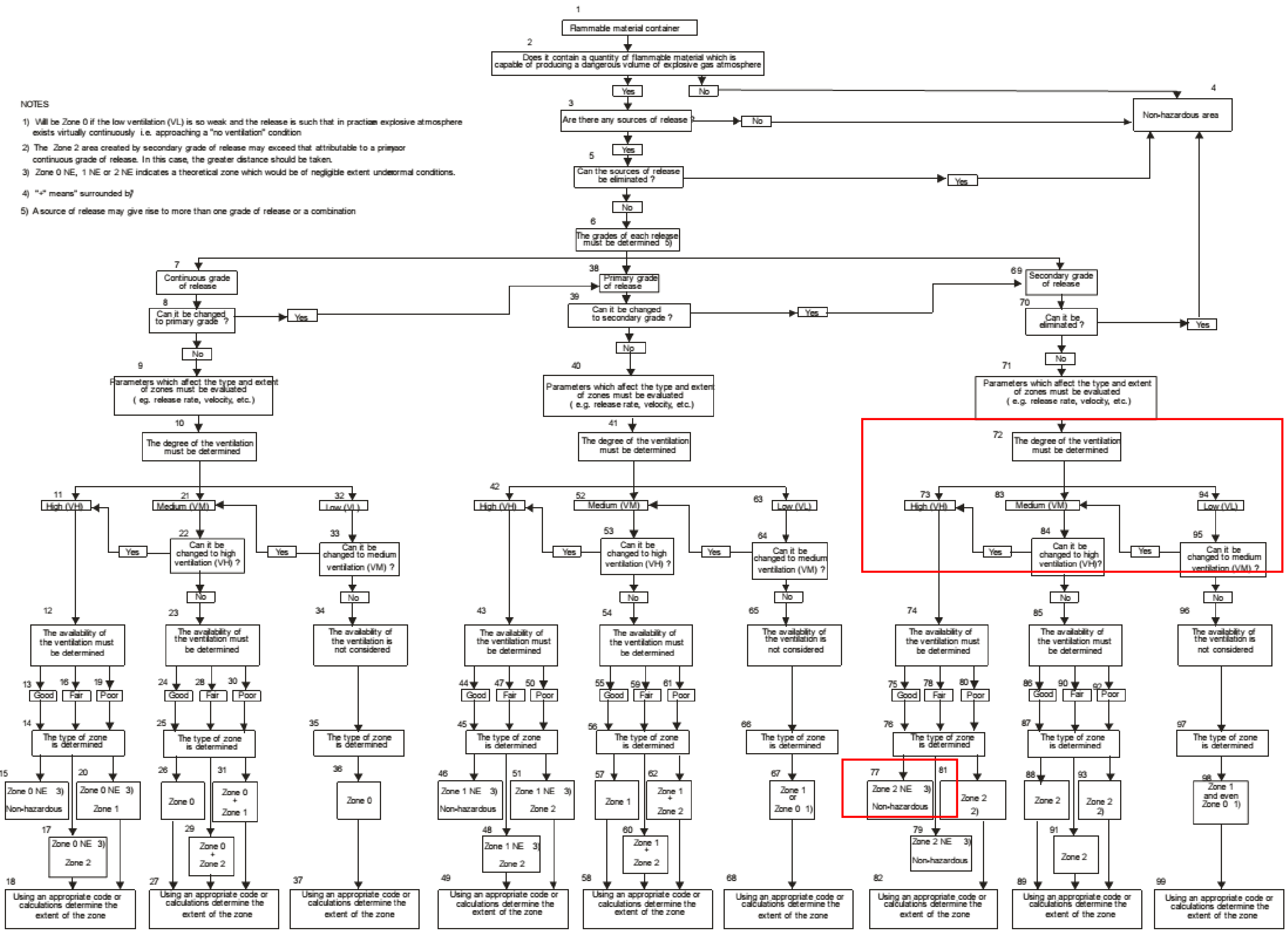
Other UK HSE guidelines also support the approach proposed.

The direct implication for foreign equipment supplied in enclosures which have a high degree of forced ventilation and include suitable gas detection provisions is that the equipment within the enclosure does not necessarily require hazardous area certification. Any OEM standard protection incorporated within the package design whether it be to North American CSA or NEC, or European ATEX standards becomes a level of “secondary” protection against ignition and explosion accounted for in the risk assessment. The main design constraint imposed by the above approach is that for Australian applications the fuel actuated isolation valves need to be located outside the enclosure to ensure that whenever the engine is not running, there is no possibility of a fuel gas leak and accumulation of gas in the enclosure.

The above is a more rigorous approach, but an extension of Fugitive Emission studies often used to de-rate the zonal classifications of compressor enclosures and buildings housing hydrocarbon equipment from Zone 1 to Zone 2. These studies are covered in API505 - Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities and cross referenced in the CEC and NEC codes.

The difference in the approach to completely declassify an area is that the dilution modelling and the specification of gas detection requirements need to be more precise than the use of empirical formula used in typical fugitive emissions studies and that the approach requires consideration of active gas detection and isolation of the fuel source external to the enclosure if a gas concentration approaching a margin from the LEL of the gas is detected.

For turbine and engine enclosures where there is a high degree of ventilation due to engine cooling requirements, a detailed analysis of gas dilution and resultant gas concentrations that may develop in the enclosure due to fugitive emissions and/or specific credible leak scenarios in conjunction with active gas detection and high integrity fuel isolation external to the enclosure may justify that any resultant hazardous area zones within the enclosure are limited to Zone 2 of “negligible extent”. By using the first principle method presented in AS/NZS 60079.19 Annexure C this may allow the space within the enclosure to be treated as a non-hazardous area provided the assessment is supported by a detailed, documented risk assessment.



Ventilation effectiveness assessed utilising CFD modelling

Figure C.2 – Schematic approach to the classification of hazardous areas

4 ALIGNMENT OF AUSTRALIAN & INTERNATIONAL STANDARDS

4.1 HAZARDOUS AREA COMPLIANCE

Australia has been actively involved in international Standards development. Australia has signed the World Trade Organisation Technical Barriers to Trade, (WTOTBT) Code of Good Practice for the Preparation, Adoption and Application of Standards, committing to the utilisation of international Standards wherever possible.

To this end many Australian standards covering the electrotechnology sector are directly aligned to the IEC standards.

The **International Electrotechnical Commission,** (IEC) is the world's leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

In addition to the IEC, within Europe, with the establishment of the European Economic Community, EEC, there was a need to promote free trade amongst member countries and as such European Standards were "harmonised" and consolidated into the "Euronorms". These are a set of standards designated by prefix EN. The EN standards apply throughout the EU and internationally in many countries with active trade links with Europe.

The application of the EN standards is governed by individual legislation in the member countries but also falls under specific EU Directives. A "Directive" is a legal act of the European Union, which requires member states to achieve a particular result without dictating the means of achieving that result. It can be distinguished from regulations which are self-executing and do not require any implementing measures. Directives normally leave member states with a certain amount of leeway as to the exact rules to be adopted. Directives can be adopted by means of a variety of legislative procedures depending on their subject matter.

Of particular relevance to this discussion is the relationship of hazardous area equipment certified to the relevant European Directives and complying with the EN standards as compared to the IEC equivalent.

Often European sourced equipment is provided with ATEX certification to the Euronorm standards rather than IEC equipment certified to the IEC Ex Scheme. The latter is directly accepted as conforming to Australian standards whereas the ATEX certifications are not in Australia.

To understand the reasons behind the different acceptance of the two certifications the following should be noted:

ATEX is the name commonly given to the two European Directives for controlling explosive atmospheres:

1) Directive 99/92/EC (also known as 'ATEX 137' or the 'ATEX Workplace Directive') on minimum requirements for improving the health and safety protection of workers potentially at risk from explosive atmospheres. This covers requirements for users of electrical equipment in hazardous areas.

2) Directive 94/9/EC (also known as 'ATEX 95' or 'the ATEX Equipment Directive') on the approximation of the laws of Members States concerning equipment and protective systems intended for use in potentially explosive atmospheres. This covers requirements for manufacturers of electrical equipment for use in hazardous areas including requirements for certification. (Currently transitioning to Directive 2014/34/EU).

It is important further to note that the EN standards are closely aligned with the IEC standards. For example IEC60079 covering hazardous areas is aligned with the corresponding EN60079 series of standards.

With respect to equipment certifications the IEC offers the IEC EX Scheme of equipment certification.

It is in the certification where the difference lies.

ATEX is a directive rather than a certifying scheme. The ATEX directive places responsibility for conformance to the Euronorm standards on manufacturers, importers and distributors. It, like all EU Directives, determines an objective that must be met but does not specify how it is to be achieved. As such equipment with an ATEX certificate is simply a declaration that the equipment has been designed and manufactured to an EN standard. It is not in itself an independently verified certification of the equipment.

In contrast the IECEx Scheme is an actual certification scheme mandating certain testing and conformity reviews, including quality auditing of manufacturers. As such equipment carrying an IEC Ex certification and marking, indicates an independently certified equipment item.

The Australian standards committee responsible for AS/NZS 60079.14 has elected to adopt a requirement for IEC Ex certification for equipment if automatic compliance is to be achieved. If this is not practical a Conformity Assessment is required.

The New Zealand standards committee responsible for AS/NZS 60079.14 has also elected to require IEC Ex certification if practical but will accept ATEX certification if the IECEx certification is not practical.

The Australian standards are therefore completely aligned with International and European standards but require a more rigorous prescriptive process when it comes to equipment certification.

GPA believes there is scope to consult with the relevant Standards Australia technical committee for AS/NZS60079.14 to explore whether the acceptance of ATEX declarations may be relaxed accepted based on specific constraints surrounding their certification without requiring a Conformity Assessment given that the underlying EN and IEC standards are generally aligned.

The Australian standards are however not directly aligned with the North American standards with respect to hazardous areas and equipment design, installation and certification.

4.2 NATIONAL GAS CODES

With respect to codes pertaining to consumer gas installations, these differ greatly between Europe, Australia and North America.

The North American codes are discussed briefly in Section 5.2.

As outlined in Section 3.3.3.7, the Technical Regulator, determines the extent to which the requirements of standards such as AS3814 are to be applied and as such there are provisions for proponents to make submissions for approval to the OTR that demonstrate the equivalent safety of their equipment.

5 NORTH AMERICAN STANDARDS

There are a number of aspects of the referenced standards that potentially differ between the North American/Canadian standards and the Australian/IEC standards as discussed below.

In Canada hazardous area requirements are covered under the Canadian Electrical Code.

> The Canadian Electrical Code, CEC, or CSA C22.1 is a standard published by the Canadian Standards Association pertaining to the installation and maintenance of electrical equipment in Canada.
>
> Two possible classifications are described in Canadian Standards Association (CSA) C22.1 Canadian Electrical Code (CEC) Section 18 (Zones) and Appendix J (Divisions).

In the USA hazardous area requirements are covered under the National Electrical Code.

> The National Electric Code (NEC), NFPA 70 as published by the National Fire Protection Association, defines area classification and installation principles. The principles of the NEC Division and Zone classification systems are applied in countries around the globe, such as in the United States.
>
> Specifically, Article 500 describes the NEC Division classification system, while Articles 505 and 506 describe the NEC Zone classification system. The NEC Zone classification system was created to provide multinational companies with a system that could be harmonized with IEC classification system and therefore reduce the complexity of management of international operations.

5.1 HAZARDOUS AREA CLASSIFICATION

5.1.1 Definition for hazardous locations in North America

In North America, hazardous locations have traditionally been defined by a combination of classes and divisions as follows:

Classes:

- Class I – A location made hazardous by the presence of flammable gases or vapours that may be present in the air in quantities sufficient to produce an explosive or ignitable mixture
- Class II – A location made hazardous by the presence of combustible or electrically conductive dust
- Class III – A location made hazardous by the presence of easily ignitable fibres or flyings in the air, but not likely to be in suspension in quantities sufficient to produce ignitable mixtures

Divisions:

- Division 1 – A location where a classified hazard exists or is likely to exist under normal conditions
- Division 2 – A location where a classified hazard does not normally exist but is possible to appear under abnormal conditions

5.1.2 North American transition to the zone system

The U.S. and Canada have recently revised installation codes to recognize an international 3-Zone area classification system for equipment used in hazardous locations.

- Zone 0 – An area in which an explosive gas atmosphere is continuously present for a long period of time
- Zone 1 – An area in which an explosive atmosphere is likely to occur in normal operation
- Zone 2 – An area in which an explosive gas atmosphere does not normally exist.

In Canada, all new installations must use the 3-Zone system. Existing installations may continue to use the 2-Division system or opt to re-classify using the 3-Zone system.

In the U.S., all installations (both new and existing) can either continue using the 2-Division system or re-classify their product using the 3-Zone system.

5.2 GAS INSTALLATION CODES

In Canada the equivalent code covering gas appliances and the subject matter of AS3814 is:

CSA-B149.1 (R2015) - Natural gas and propane installation code

Targeting Canadian gas and propane industry workers, this standard reflects the latest advances in technology and corresponding safety requirements. It has been reviewed by regulatory authorities across Canada, and has been adopted into law in every Canadian province and territory. CSA-B149.1 applies to the installation of:

- Appliances, equipment, components, and accessories where gas is to be used for fuel purposes
- Piping and tubing systems
- Vehicle-refuelling appliances and associated equipment
- Stationary gas engines and turbines

In the USA the codes for gas appliances and gas installations include:

- **NFPA 54 ANSI Z223.1 National Fuel and Gas Code**
- **NFPA 37 Standard for installation and use of stationary gas engines and turbines**

In both Canada and the USA there are further specific guidelines for gas engine and turbine installation associated with transmission pipelines and hydrocarbon processing facilities.

GPA has not reviewed the above North American standards in detail. However as previously stated and outlined in Section 3.3.3.7, the Technical Regulator, determines the extent to which the requirements of standards such as AS3814 are to be applied and as such there are provisions for proponents to make submissions for approval to the OTR that demonstrate the equivalent safety of their equipment based on the above foreign codes.

6 SAGE ENERGY CORPORATION CLARIFICATIONS

In a letter from Sage Energy Corporation to Michael Malavazos of DSD a number of specific issues were raised with respect to compliance with Australian standards for packaged compression equipment.

Excerpts of the letter with specific bullet points added by Sage appear below which summarise the concerns. GPA's response and guidance is provided in each case.

1. *The compliance obligations under AS 3814 for Type B appliances and in particular the question between conformance audits focusing on the letter of the standard or the intent of the standard, that is, safety/reliability outcomes.*
   - Conformity assessment costs and complexity.

As stated in previous sections, AS3814 does allow some concessions from the "letter of the standard" if it can be demonstrated that the intent of the standard is met. This is simply a matter of detailing the departures and how they are dealt with in the technical submission to the OTR if required in the state or territory where the equipment is to be installed. It is agreed these conformity assessment cost money, however if essentially standard packages are to be transported and supplied to the Australian market, the cost of the analysis should only be a once off cost for each diverse equipment package to be sold and should not dramatically impact the cost of individual units.

2. *Electrical wiring requirements under AS60079 relating to electrical installations within Hazardous Areas.*
   - Hazardous area Classifications – Fugitive Emissions Study (as per API 4322 and Paragraph 6.6.2.4.8 of API RP505) to validate the Zone 2 area in compressor enclosures.
   - Electrical wiring methods: i) What is considered adequate mechanical protection; ii) Non-incendive circuit device and wiring requirements;
   - Electrical Wiring cable needs to be considered for durability and vermin control – is this a code requirement (industry currently accepts harness style wiring on engines)
   - IEC approval - Remove the need for conformity assessment for CSA approved devices (thus far every CSA approved device has passed). If this cannot be achieved, facilitate the reuse of device conformity assessments across various customers, regions, and states.

Fugitive emissions studies would be a valid approach to ensuring an enclosed area can be classified as Zone 2 rather than Zone 1 provided the fuel isolation is external to the package such there is no fuel in the enclosure piping when the ventilation system is not running. The reason for this is that if there is a small undetected leak on the upstream flange of the fuel isolation point and it is in the enclosure, then a flammable atmosphere above the LEL of the fuel gas could form whilst the engine is shut down and be ignited during the subsequent next start of the equipment. In any event this only addresses a Zone 2 versus Zone 1 classification. Adherence to AS60079.14 equipment certification and installation requirements as previously discussed would still apply. GPA has suggested ways of potentially declassifying the enclosure by active gas detection and shutdown and detailed dilution analysis utilising techniques such as CFD. It is acknowledged this again is not an inexpensive exercise and may be a significant cost impost for a single unit. However if a quantity of similar units are proposed for import, then the cost of the analysis may prove insignificant when shared amongst multiple units.

With respect to wiring methods, these must comply to the IEC/AS/NZS standards for the protection technique adopted. Mechanical protection is assessed on the basis that a cabling system should not be able to be damaged based on inadvertent contact, vibration, abrasion exposure to heat etc. Generally this implies installation in conduits or cable tray/ladder and/or may be covered by the use of armoured cabling. The requirements for durability and vermin control are often imposed by Clients that have had experience with damage due to these causes. It is not an unreasonable consideration. Harness style wiring on engines is not necessarily precluded but this would have to be assessed based on a specific design, the protection technique utilised etc.

The IEC approval process and justification for it has been well documented in the report. Removal of this requirement is a major compromise of the standard which cannot be considered independently of the Australian Standards committee responsible for the AS60079 series. However we believe the re-use of device conformity assessments for various customers, regions and states is valid provided the installation details are not significantly different in any way. For example for a particular packaged compressor design, to be installed in an Australian onshore region, GPA believes a common conformity assessment which can be included in the site specific hazardous area verification dossier is acceptable. This approach has been accepted in many installations GPA has been involved with.

3. *How much of this apparent redundancy and integrity level of control required on your machines for Australian market is driven by interpretation of these standards or by internal company requirements or both.*

- We agree that much of the Australian market is driven by overzealous interpretation of these standards by industry experts.
- Pressure Vessels provided by SAGE are reviewed and approved with full documentation to (ASME section VIII) by the manufacturer as required by that code; to then perform a full design re-review of these vessels in Australia is an unnecessary additional cost and a redundant process offering no additional safety or value.

GPA does not share the view that much of the Australian market is driven by overzealous interpretation of standards by industry experts. However GPA does support pragmatic interpretations of the standards where it is clear an alternative design offers an equivalent level of safety. In the Australian context for the standards reviewed, despite all parties in the supply chain sharing responsibility for the safety of personnel and suitability of equipment for use, the responsibility for safety ultimately lies with the end operator/asset owner. As such they must be satisfied that a case for safety of their equipment can be made. As an OEM it is therefore important that for the equipment and scope under their control a well document assessment of compliance, identification of deviations from the standards and an assessment of risk is provided with their equipment and that every reasonable attempt to conform to the standards is made. GPA’s experience is that if this is well presented to both Clients and technical regulators approvals are rarely denied. Further, again it must be stressed that for equipment packages of substantially non-differing designs and manufacture this case can be made once and applied to multiple units to minimise any cost imposts.

With respect to AMSE VIII vessels, these are acceptable under Australian legislation provided they are fully documented and tested in accordance with the AMSE VIII standards requirements. Although vessels designed to AS1210 are preferred, GPA has experienced no difficulties in having ASME VIII vessels accepted in Australia provided they carry all the necessary design documentation required of an AMSE VIII vessel. Requirements for third party verification and or vessel registration are a legislative requirement in general and not a Standards’ requirement.

7 RECOMMENDATIONS & CONCLUSIONS

Compliance with national legislation, standards and codes of practice poses challengers for foreign equipment suppliers wishing to import pre-assembled equipment into the Australian market.

This is specifically true of the importation of packaged gas compression equipment powered by gas engines or turbines.

Specific requirements imposed by compliance with the AS/NZS60079 series of hazardous area standards and the requirements for compliance to national gas codes, including AS 3814 applying to gas fired appliances, differ from corresponding requirements imposed by equivalent North American standards.

Based on GPA's specific review of the standards in the preparation of this report and extensive experience working in the Australian on-shore oil and gas industry the following observations are made:

- Australian authorities have made significant progress in aligning Australian Standards with internationally accepted standards and in particular the IEC standards as they apply to hazardous areas. Australia is a signatory to the World Trade Organisation Technical Barriers to Trade, (WTOTBT) Code of Good Practice for the Preparation, Adoption and Application of Standards, committing to the utilisation of international Standards wherever possible.
- With respect to hazardous area regulation, Canada and the USA have acknowledged the need to align themselves with foreign standards to allow trade on an international basis and are moving towards adherence to IEC standards. This is optional in the USA but mandatory for all new hazardous installations in Canada.
- Where Australian standards deviate from international standards, including specific requirements of AS3814 and competency and certification requirements for hazardous area electrical equipment as detailed in AS60079.14, the additional requirements have been included in an attempt to achieve a higher level of safety and documented traceability that may be achieved if the requirements are relaxed.
- In most cases the Australian standards provide the flexibility to allow deviations from the "letter of the standards" provided a documented case is presented that demonstrates safety is not compromised by the alternative design.
- Although open to interpretation, GPA's experience and opinion is that for packaged equipment that is essentially identical across multiples units, these documented justifications need only be made on a once off basis for each standard design, thus not representing a significant cost impost to foreign importers wishing to establish facilities in Australia.
- With respect to local assembly and packaging in Australia, there is a decided advantage in adherence to Australian standards due to a large pool of trained and certified tradespersons, familiar with the local standards being locally available.

Specific observations with respect to hazardous area compliance and Type B gas appliance requirements presented for consideration by foreign equipment suppliers include:

- With respect to AS3814 and Type B appliance certification; provided a written case is made, supported by risk assessment, that the foreign equipment supplied provides an equivalent level of safety and risk to that if it were fully compliant, then the Australian standard allows flexibility in its approval. Acceptance of equipment to foreign standards is reliant on a documented case being presented to the technical regulator. For an OEM supplying packaged equipment, this case can be documented once and submitted for each equipment package provided they are equivalent.
- With respect to AS60079.14 hazardous area equipment conformity assessment and OEMs; GPA believes that although the Standard requires unique conformity assessments based on specific applications, in the case of packaged equipment which is of a standard reproducible design that is repeatedly installed in typical operating environments, it is acceptable to obtain Conformity Assessments for the standard design on a once off basis and present this for inclusion in site specific hazardous area dossiers.
- With respect to the classification of hazardous areas within engine and turbine enclosures to AS/NZS60079.10.1; For enclosures where there is a high degree of ventilation due to engine cooling requirements, a detailed analysis of gas dilution and resultant gas concentrations that may develop in the enclosure due to fugitive emissions and/or specific credible leak scenarios in conjunction with active gas detection and high integrity fuel isolation external to the enclosure may justify that any resultant hazardous area zones within the enclosure are limited to Zone 2 of "negligible extent". By using the first principle method presented in AS/NZS 60079.19 Annexure C this may allow the space within the enclosure to be treated as a non-hazardous area provided the assessment is supported by a detailed documented risk assessment.
- Fugitive emission studies to API505 standard are acceptable in making cases for the derating of zonal classifications in enclosed areas but must be presented in the context of an overall risk assessment and justification.
- For consideration by Australian standards authorities; GPA believes there is scope to consult with the relevant Standards Australia technical committee for AS/NZS60079.14 to explore whether the acceptance of ATEX declarations may be relaxed based on specific constraints surrounding their certification without requiring a Conformity Assessment given that the underlying EN and IEC standards are generally aligned. This would also align the Australian and New Zealand requirements for non-IECEx certified equipment.

Based on the above, GPA does not believe there are compelling reasons to justify generalised waivers or amendments to Australian standards with respect to foreign equipment. Rather where a deviation is not able to be practically addressed by redesign due excessive cost or design constraints, a documented case accompanied by a risk assessment addressing the non-compliance is acceptable to technical regulators and provided for by existing flexibility in the standards in most cases.

APPENDIX 1 AUSTRALIAN ACTS AND REGULATIONS

The following table details the relevant Acts and regulations in each state of Australia, pertaining to Gas Appliance certification and Hazardous area compliance.

AS 3814:2015 Industrial and commercial gas-fired appliances

State or Territory	Relevant Act	Subordinate Legislation - Regulations	Requirement for Type B Appliance certification and registration in petroleum production and transmission operations.
South Australia	SA Gas Act 1997	SA Gas Regulations 2012	Not Required for activities covered under the Petroleum Act unless appliance is connected to gas distribution network infrastructure.
Western Australia	WA Gas Standards Act 1972	WA Gas Standards (Gas Fitting and Consumer Gas Installations) Regulations 1999	Required
Queensland	QLD Petroleum and Gas (Production and Safety) Act 2004	QLD Petroleum and Gas (Production and Safety) Regulation 2004	Required
Northern Territory	Dangerous Goods Act 2012 Energy Pipelines Act 2015 Petroleum Act 2016	Dangerous Goods Regulations 2015 Pipelines Act and Petroleum Act Regulations	Required for consumer installations. Consult with technical regulator as exemptions apply under the Pipelines Act or Petroleum Act.
Tasmania	Tasmanian Gas Act 2000	Tasmania Gas safety Regulations 2014	Required
New South Wales	NSW Gas Supply Act 1996	NSW Consumer Gas Regulations	Consult with Technical Regulator Many regulations only apply to consumer installations for appliance inlet pressures less than 200kPag.
Victoria	VIC Gas Safety Act 1997	The Gas Safety (Gas Installation) Regulations 2008	Required

AS/NZS 60079 Electrical equipment in explosive atmospheres

State or Territory	Relevant Act	Subordinate Legislation - Regulations	Primary Legislated Standard
South Australia	South Australian Electricity Act 1996	South Australian Electricity (General) Regulations 2012	AS/NZS 3000:2007 The Wiring Rules
Western Australia	WA Electricity Act 1945	WA Electricity Regulations 1947	AS/NZS 3000:2007 The Wiring Rules
Queensland	QLD Electrical Safety Act 2002	QLD Electrical Safety Regulations 2013	AS/NZS 3000:2007 The Wiring Rules
Northern Territory	NT Electricity Reform Act 2016	NT Electricity Reform (Safety & Technical) Regulations 2016	AS/NZS 3000:2007 The Wiring Rules
Tasmania	Electricity Industry Safety and Administration Act 1997	Managing Electrical Risks in the Workplace Code of Practice December 2012 CP117	AS/NZS 3000:2007 The Wiring Rules
New South Wales	NSW Electrical Safety Act 2002 NSW Electrical (Consumer Safety) Act 2004	NSW Electrical (Consumer Safety) Regulations 2015.	AS/NZS 3000:2007 The Wiring Rules
Victoria	VIC Electricity Safety Act 1998	VIC Electricity Safety (Installations) Regulations 2009	AS/NZS 3000:2007 The Wiring Rules