

AILERON MAINLINE VALVE STATION HAZARDOUS AREA DOSSIER



FYFE REFERENCE: 18756-4-HAD-006

APA REFERENCE: HAD DATA REPOSITORY/ ADP_0241_ALM\$

Prepared by:

Arjun Patel
Graduate Process Engineer - Fyfe

Date: 21-Sep-2011

Reviewed by:

Tony Bird
Principal Process Engineer - Fyfe

Date: 21-Sep-2011

Client Accepted:

Anthony Comerford
Pipeline Engineer – APA Group

Date:

Manager:

Henry Dupal
Engineering Manager - APA Group Northern Territory

Date:

Credential Exposure

PERSONNEL

Tony Bird from Fyfe Pty Ltd is a principal process engineer with over ten years of experience in hazardous area classifications of new and existing projects. His experience in the development of retrospective hazardous area classifications includes Palm Valley gas plant, Torrens Island power station, Pelican Point power station and numerous Santos facilities.

His experience covers oil and gas pipeline and facility projects during all stages of design from concept, feasibility, and FEED through to detailed design. He also has experience in procurement, construction supervision, commissioning and operations support of pipeline facilities.

Tony's responsibilities for this project included the examination of site, confirmation of installed equipment, and development of hazardous area classification and hazardous area mapping drawings.

Daniel Williams from Sitzler Pty Ltd is a sub-contract industrial/commercial electrician with experience in various hazardous area installations and inspections. His competencies in accordance to AS/NZS 4761 include (Refer attachments):

UTE NES 010 A	Report on integrity of explosion protected equipment in hazardous areas
UTE NES 107	Install explosion-protected equipment and wiring systems (Ex)
UTE NES 214	Maintain equipment in hazardous areas (Ex)
UTE NES 408	Test installations in hazardous areas (Ex)
UTE NES 409	Inspect visually existing hazardous area installations (Ex)
UTE NES 410	Inspect in detail hazardous area installations (Ex)

He was previously an electrical supervisor for the Blacktip gas plant construction, hazardous area inspector / supervisor and leading hand electrician for the Darwin LNG plant, and construction electrician for the Darwin biodiesel plant.

Daniel's role for this project was to perform close inspection of all electrical equipment in accordance to AS/NZS 60079 series on site to verify installation.

Neville Green from Sitzler Pty Ltd is an electrical engineer with over ten years of experience in the design, construction, commissioning and inspection of installation in hazardous environment in the oil and gas industry. Neville has the following competencies in accordance to AS/NZS 4761(Refer attachments):

UTE NES 010 A	Report on integrity of explosion protected equipment in hazardous areas
UTE NES 107	Install explosion-protected equipment and wiring systems (Ex)
UTE NES 707	Design electrical installations in hazardous areas (Ex)

Neville's role was to review inspection sheets and provide recommendations for remedial actions to ensure compliance.

Michael Hayden from Fyfe Pty Ltd is the surveyor who completed three dimensional (3D) scanning and photography of the facilities. The 3D images were used by Fyfe drafters to update site arrangement drawings. The 3D scan data is retained by Fyfe for future use if required by APA Group.

METHODOLOGY

The Hazardous Area Verification Dossier is produced to ensure that the installation complies with the appropriate certification documents as well as with AS/NZS 2381.1 and any other relevant part of the AS/NZS 2381 and AS/NZS 60079 series. In addition equipment and installations where hazardous areas exist are required to comply with the applicable regulations of the applicable Australian State or Territory. It should be borne in mind that an installation can come under the jurisdiction of several authorities with different areas of responsibility, e.g. mining, electrical safety, handling and transport of flammable materials and occupational health and safety.

This dossier has been prepared in accordance with the following codes and standards:

- Dossiers AS 2381.1:2005 - Electrical equipment for explosive gas atmospheres - Selection, installation and maintenance Part 1: General requirements
- Hazardous area AS/NZS 60079.10.1:2009 - Explosive atmospheres: Classification of areas - Explosive gas atmospheres (IEC 60079-10-1, Ed. 1.0 (2008) MOD) (2009)
- AS/NZS 60079.17:2009 : Explosive atmospheres - Electrical installations inspection and maintenance (IEC 60079-17, Ed.4.0 (2007) MOD)

Note that a Hazardous Area Verification Dossier is a living document and should be updated by APA and / or its contractors. Any modifications to electrical equipment, including removing an instrument cover should be recorded and stored within the Dossier. Changes to the operation or equipment installed within the station will require a review of the hazardous area classification and may require revision of the classification, hazardous area mapping drawings, hazardous area equipment lists and associated certificates of conformity. An extract from AS 2381.1 (2005) is included STET to provide guidance to APA.

Equipment requires conformity to the following standards:

- AUS Ex
- IEC Ex

Previously AS / NZS Ex and FLP have been recognised certification standards for equipment in hazardous areas and may have been applicable at the time of construction / installation. Equipment that was identified as having any of the certification to show conformity to the above standards was deemed to be acceptable. Where no certification was available or certification was available to standards not recognised in Australia, a conformity assessment document (CAD) is required. The CAD shall be completed by a suitably qualified organisation and the associated residual risk shall be accepted by the head of APA. For new installations, equipment with the correct certificates of conformity should be used unless no item exists and then a CAD should be produced. No information on the date of installation/ of equipment purchase/manufacturer has been provided of the

site. Therefore no checking has been undertaken to determine the currency of the certificate at the time of installation.

DISCLAIMER

Opportunities for improvements (OFI) are provided for items associated with hazardous area and general engineering. The scope of work for the project was to identify hazardous area and provide visual inspection of the equipment. The visual inspection did not include opening of equipment and the OFIs are limited to the level of inspection. General engineering OFIs are non-exhaustive and require APA to confirm the OFI and the recommendation.

Extract from AS 2381.1 (2005)

1.6 DOCUMENTATION

It is necessary to ensure that any installation complies with the appropriate certification documents 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 plant and shall be either kept on the premises or stored in another location in which 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. This dossier should contain the information detailed in the appropriate Parts of this series of Standards for the types of protection concerned.

Up-to-date information typically required is as follows:

- a) Where applicable a statement of the identity of the person(s) having legal ownership of the installation or parts thereof and where the verification dossier is located.*
- b) The classification of hazardous areas and the Standards used for the classification.*
- c) Equipment group and temperature class.*
- d) Installation instructions.*
- e) Documentation/certification for electrical equipment, including those items with special conditions, for example, equipment with certificate numbers that have the suffix 'X'.*
- f) Descriptive system document for the intrinsically safe system.*
- g) Documentation relating to the suitability of the equipment for the area and environment to which it will be exposed, e.g. T rating, Ex rating, IP rating, corrosion resistance.*
- h) Documentation certifying that the equipment is rated for the voltages and frequency applied during normal operation.*
- i) Manufacturer's/qualified person's declaration, e.g. tradesperson's documentation and inspector's inspection reports.*
- j) Records sufficient to enable the explosion-protected equipment to be maintained in accordance with its type of protection (for example, list and location of equipment, spares, technical information).*
- k) Records covering any maintenance, overhaul and repair of the equipment.*
- l) Records of selection criteria for cable entry systems for compliance with the requirements for the particular explosion technique.*
- m) Drawings and schedules relating to circuit identification (see Clause 3.8.16).*
- n) In New Zealand, the Hazardous Area Statement of Periodic Verification on completion of a periodic inspection. (Refer to Appendix B).*

Where alternative methods of equipment identification are used for inspection in accordance with Clause 4.3 then additional documentation to support the traceability of the equipment shall be provided.

It shall be the responsibility of the person(s) having legal ownership of the installation or parts thereof to ensure that the relevant information is produced but the preparation of the document may be delegated to expert bodies/organizations. The dossier may be kept as hard copy or in electronic form.

1.7 QUALIFICATIONS OF PERSONNEL

The design, construction, maintenance, testing and inspection of installations covered by this Standard shall be carried out only by competent persons whose training has included instruction on the various types of protection and installation practices, relevant rules and regulations and on the general principles of area classification. The competency of the person shall be relevant to the type of work to be undertaken.

Appropriate continuing education or training should be undertaken by personnel on a regular basis.

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.

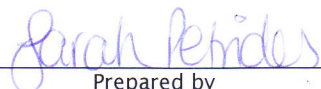
This is a Statement that

Dan Williams

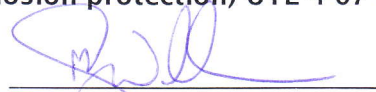
Has been assessed as having fulfilled the following requirements

UTE NES 010 A	Report on the integrity of explosion-protected equipment in hazardous areas
UTE NES 107 TA	Install explosion-protected equipment & wiring systems (Ex mixed)
UTE NES 107 WA	Install explosion-protected equipment & wiring systems (Ex n)
UTE NES 107 XA	Install explosion-protected equipment & wiring systems (Ex i)
UTE NES 107 YA	Install explosion-protected equipment & wiring systems (Ex e)
UTE NES 107 ZA	Install explosion-protected equipment & wiring systems (Ex d)
UTE NES 214 TA	Maintain equipment in hazardous areas (Ex mixed)
UTE NES 214 WA	Maintain equipment in hazardous areas (Ex n)
UTE NES 214 XA	Maintain equipment in hazardous areas (Ex i)
UTE NES 214 YA	Maintain equipment in hazardous areas (Ex e)
UTE NES 214 ZA	Maintain equipment in hazardous areas (Ex d)
UTE NES 408 TA	Test installations in hazardous areas (Ex mixed)
UTE NES 408 WA	Test installations in hazardous areas (Ex n)
UTE NES 408 XA	Test installations in hazardous areas (Ex i)
UTE NES 408 YA	Test installations in hazardous areas (Ex e)
UTE NES 408 ZA	Test installations in hazardous areas (Ex d)
UTE NES 409 TA	Inspect visually existing hazardous area installations (Ex mixed)
UTE NES 409 WA	Inspect visually existing hazardous area installations (Ex n)
UTE NES 409 XA	Inspect visually existing hazardous area installations (Ex i)
UTE NES 409 YA	Inspect visually existing hazardous area installations (Ex e)
UTE NES 409 ZA	Inspect visually existing hazardous area installations (Ex d)
UTE NES 410 TA	Inspect in detail hazardous area installations (Ex mixed)
UTE NES 410 WA	Inspect in detail hazardous area installations (Ex n)
UTE NES 410 XA	Inspect in detail hazardous area installations (Ex i)
UTE NES 410 YA	Inspect in detail hazardous area installations (Ex e)
UTE NES 410 ZA	Inspect in detail hazardous area installations (Ex d)

in partial completion of the following qualification
Certificate IV in Electrotechnology (Explosion-protection) UTE 4 07 99



Prepared by
Sarah Petrides
Administration Assistant



Approved by
Michael Williams
Certified Trainer and Assessor

National Provider Code 51160

Date of Issue: 31 May 2007



This statement of attainment is recognised within the Australian Qualifications Framework



This is to certify that
Neville Green
of
GPA Engineering Pty Ltd

Completed the 3 day
Electrical Safety in
Hazardous Areas

Training Course
26th to 28th February 2001

Signed: *CR Baker*

Colin Baker CEng, MIEE, MInstMC, FIICA
Partner, Principal Consultant & H-Class Electrical Inspector

Certificate Number: 2001.02.26-28/05

This 24 hour short course is recognised by
The Institution of Engineers, Australia, for Continuing Professional Development (CPD) purposes

Explosion Protection Technology, 8 Kirkfell Court, Berwick, Victoria 3806, Australia

This is a Statement that

Neville Owain Green

has been assessed as having fulfilled the following requirements

UTE NES 010 A	Report on the integrity of explosion-protected equipment in hazardous areas
UTE NES 107 TA	Install explosion-protected equipment & wiring systems (Ex mixed)
UTE NES 107 WA	Install explosion-protected equipment & wiring systems (Ex n)
UTE NES 107 XA	Install explosion-protected equipment & wiring systems (Ex i)
UTE NES 107 YA	Install explosion-protected equipment & wiring systems (Ex e)
UTE NES 107 ZA	Install explosion-protected equipment & wiring systems (Ex d)
UTE NES 707 TA	Design electrical installations in hazardous areas (Ex mixed)
UTE NES 707 WA	Design electrical installations in hazardous areas (Ex n)
UTE NES 707 XA	Design electrical installations in hazardous areas (Ex i)
UTE NES 707 YA	Design electrical installations in hazardous areas (Ex e)
UTE NES 707 ZA	Design electrical installations in hazardous areas (Ex d)

in partial completion of the following qualification
Certificate IV in Electrotechnology (Explosion-protection) UTE 4 07 99


Prepared by
Sarah Petrides
Administration Assistant


Approved by
Sam Zacha
Managing Director

National Provider Code 51160

Date of Issue: 5 December 2007



This statement of attainment is recognised within the Australian Qualifications Framework

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Revision History:

Rev.	Status	Date	Prepared	Reviewed	QA
A	Preliminary issue for client's review	24-Aug-2011	SNT	TCB	
0	Original Issue	21-Sep-2011	AZP	TCB	EZG

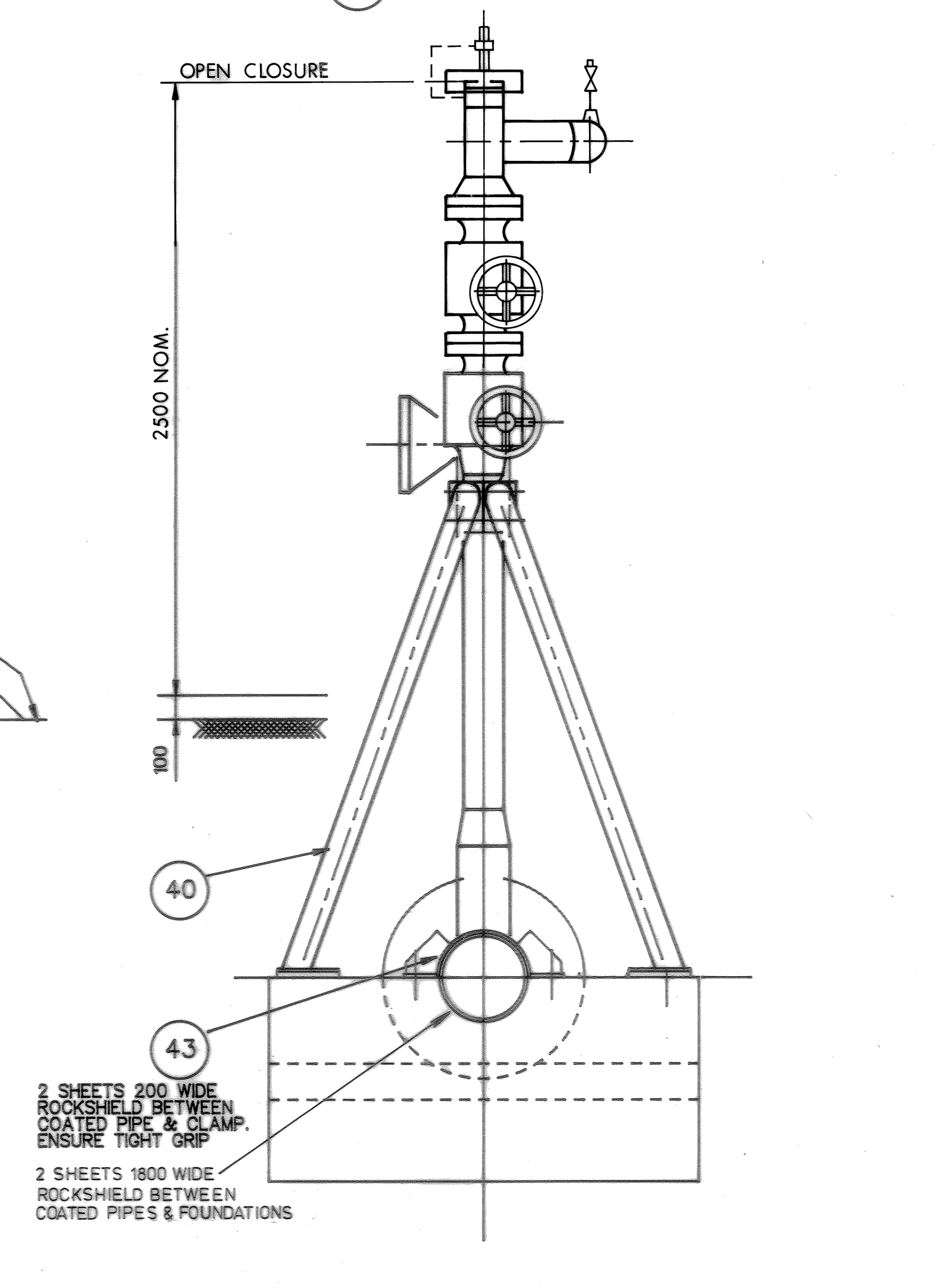
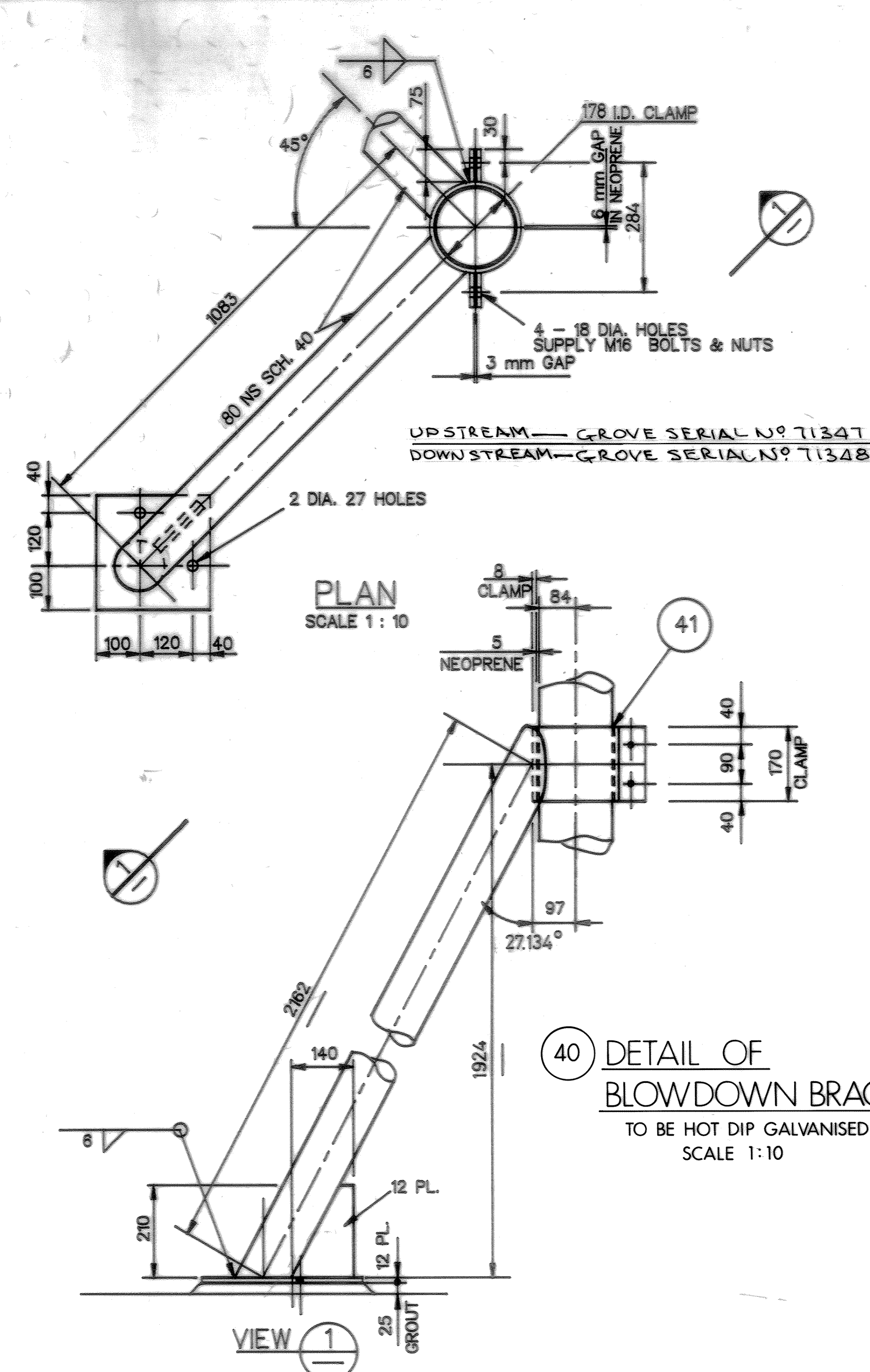
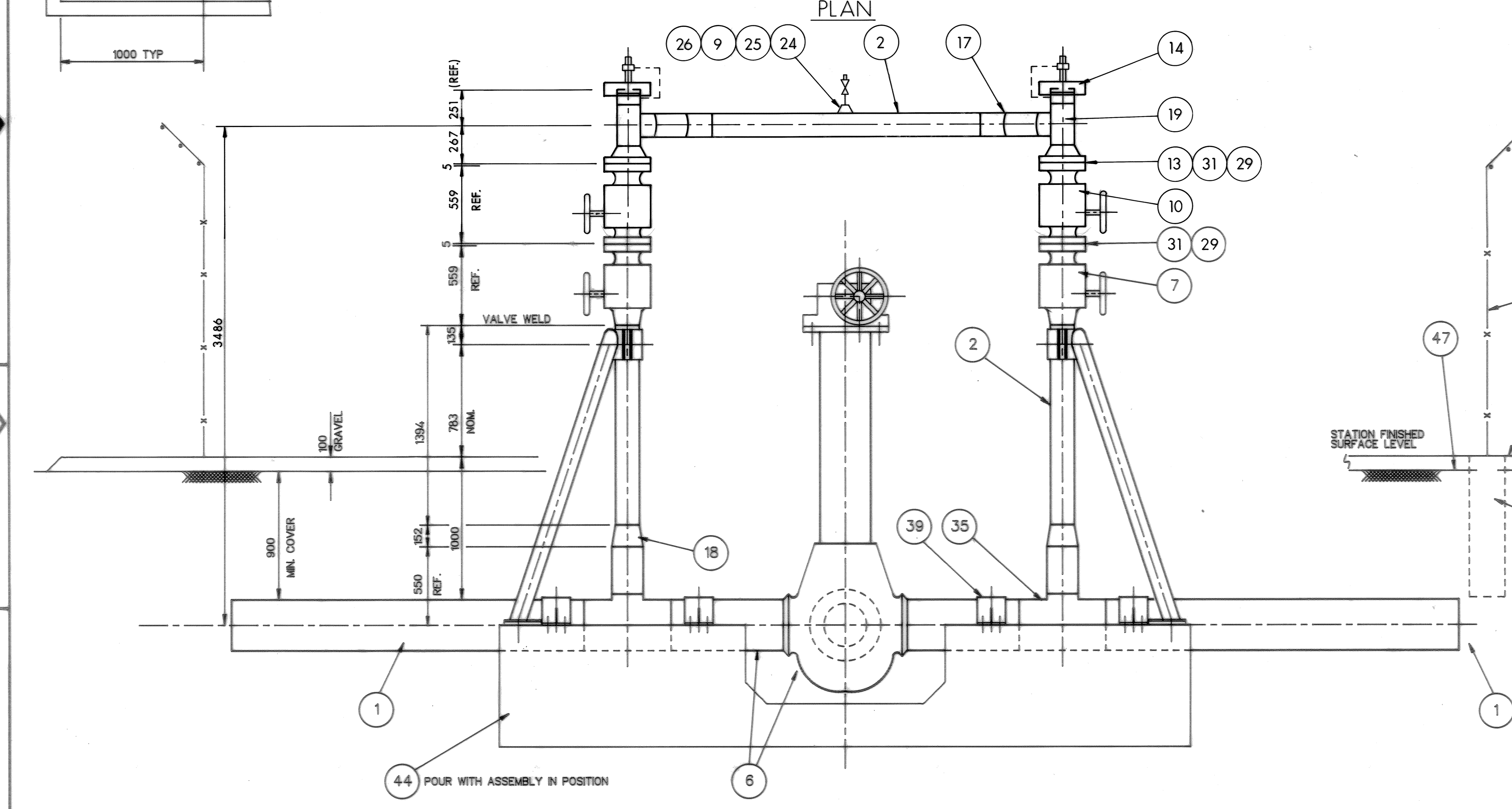
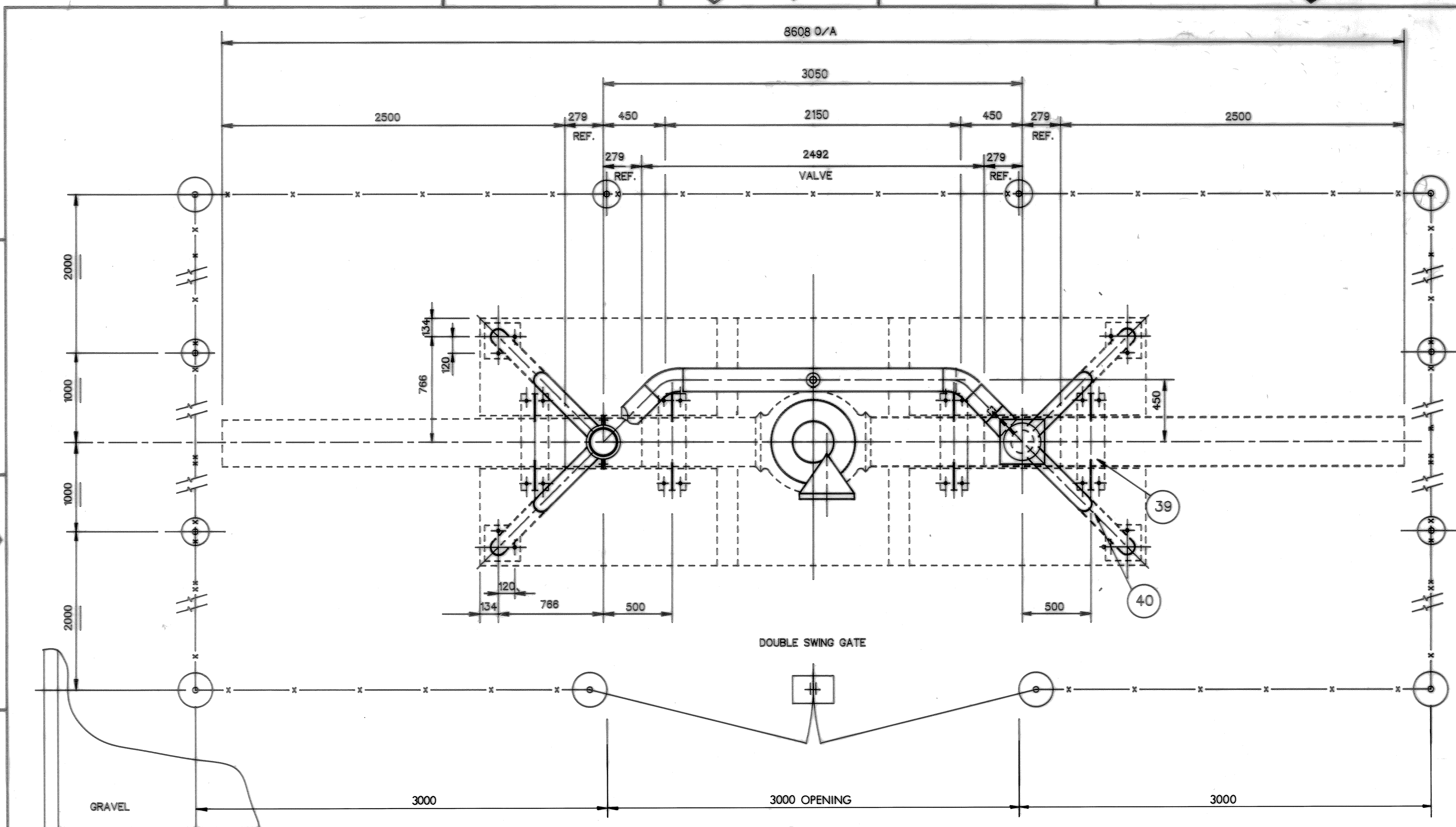
1 Site Information

An inspection on the Aileron mainline valve site was performed on 4 August 2011 by Tony Bird, a senior process engineer from Fyfe and Daniel Williams, a sub-contract industrial/commercial electrician from Sitzler.

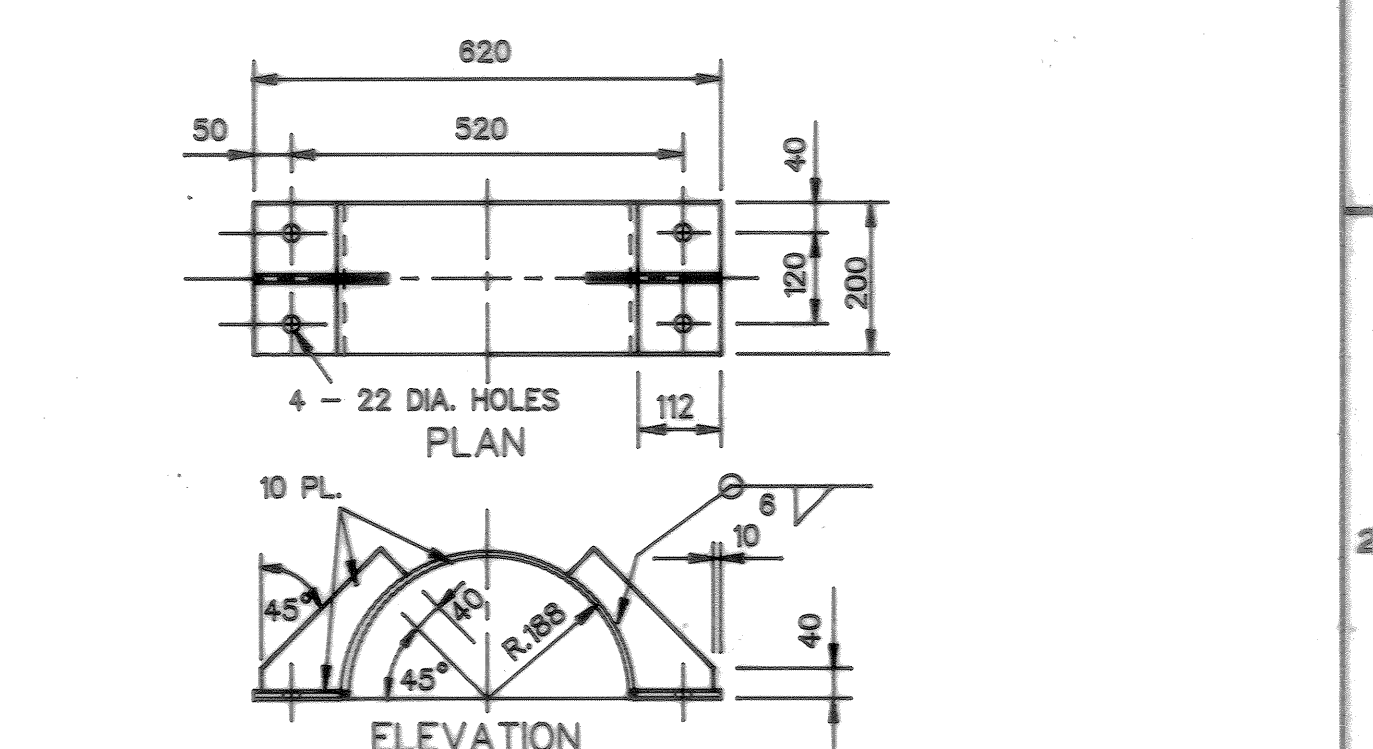
Aileron is located at KP0241 on the Amadeus Basin to Darwin Pipeline. The site comprises of a buried valve with an above ground bypass and vent points with no instrumentation installed on the mainline valve. The buried valve has a manual actuator, injection ports and cavity bleed extended above ground.

The site arrangement drawings and P&IDs for the Aileron mainline valve station can be found overleaf.

Drawing Number	Description	Revision
<i>APA Group Arrangement Drawing</i>		
AD 0231-6010	Mainline Valve Assembly 350 NS	1
<i>Fyfe Updated Plot Plan</i>		
AD 0241-6011	Mainline Valve 350 NS Plot Plan – Aileron	0
<i>P&ID</i>		
AD TYP-7013	Typical 305 mm DIA Mainline Valve	1



ITEM	QTY.	DESCRIPTION	CODE NO.
* INDICATES MATERIAL TO BE SUPPLIED BY PRINCIPAL			
1	5.0m	PIPE 350 NS 8.74 WT API SL X 80	C0008
2	5.8m	PIPE 150 NS XS ASTM A106 B	C0064
3			
4			
5			
6	1	VALVE BALL 350 NS 800# WE XS FULL BORE 2492 VALVE LGTH. PUP. GEAR OPERATOR MOUNTED ON EXTENSION 2100 ABOVE @ VALVE GROVE SERIAL N° 7141B	C0160
7	2	VALVE BALL 150 NS 800# FE RF/WE XS INC. GEAR OPERATOR	C0180
8			
9	1	VALVE BALL 25 NS 800# SW/NPT	C0240
10	2	ORBIT BALL VALVE 150 NS 600# RF/RF XS INC. GEAR OPERATOR	
11			
12			
13	2	FLGE WN 150 NS 800# RF XS ASTM A105	C0538
14	2	CLOSURE 150 NS 800# WE XS ASTM A105 VERT C/W DAVIT	C0899
15			
16			
17	2	ELBOW 45° 150 NS XS ASTM A234 WPB	C0738
18	2	REDUCER CON 200 x 150 NSXS ASTM A234 WPB	C0818
19	2	TEE EQUAL 150 NS XS ASTM A234 WPB	C0755
20			
21			
22			
23			
24	1	SOL 250-150 x 25 NS 3000# ASTM A105	
25	1	NIPPLE 25 NS x 100 SCH 160 PBE ASTM A106	
26	1	PLUG HEX HD 25 NS SCR NPT ASTM A105	
27			
28			
29	48	STUDBOLT 1" UNC x 170 C/W 2 NUTS ASTM A193 B7 ASTM A194 2H	
30			
31	4	GASKET 150 NS 800# 4.4mm THK METAFLEX SG	
32			
33			
34			
35	2	TEE RED BAR 350 x 200 NS DRG No AD0000-6103	
36			
37			
38			
39	4	PIPE CLAMP (FABRICATE AS DETAILED)	
40	2	BLOWDOWN BRACE (FABRICATE AS DETAILED)	
41	2	NEOPRENE SHEET - 80 DUROMETER 5 THK 170 x 544	
42			
43	AS REQD	ROCKSHIELD 5mm THK	
44	1	FOUNDATION DRG No AD0000-1002	
45	1 SET	FENCE 2 RAIL TYPE 2.29m HIGH INCL 45° OVERHANG 30m O/A LENGTH COMPRISING 4 CORNER, 2 GATE & 6 INTERM POSTS, DOUBLE GATE 3.0m OPENING WITH DROP BOLTS & LOCK, CHAINWIRE MESH, BARB WIRES - GALVANISED CYCLONE OR EQUIV.	
46	1 SET	FENCE FOUNDATIONS COMPRISING 8 / 250 DIA x 1010 DEEP CORNER/GATE POST FOOTINGS, 8 / 200 DIA x 710 DEEP INTERM. POST FOOTINGS ONE 300 x 200 x 200 DEEP GATE PAD WITH 2 HOLES FOR DROP BOLTS - 20 MPa MASS CONCRETE	
47	90m ²	POLYTHENE SHEET 0.1 mm THK (COVER AREA GIVEN)	
48	9m ³	GRAVEL GRADED (COMPACTED VOLUME GIVEN)	



ASD9006142

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DWG. No.	REFERENCE DRAWINGS
AD0000-7013	P & I DIAGRAM

NOTES.

1. ROCKSHIELD TO BE FIXED WITH PLASTIC TIES TO ENSURE TIGHT FIT WITH SURFACE COATING

APPROVED FOR CONSTRUCTION

AS BUILT

No.	DATE	REVISION	By	CHKD.	ENG.	PROJ. MGR.	APPD.
1	29-9-89	2 - 150NS VALVES (ITEM 10) ADDED; ITEM 29 QUANTITY WAS 24; ITEM 31 QUANTITY WAS 2	T.L.				
0	29-1-87	REPRODUCED FROM AD0000-6010 REV.1, VALVE SERIAL NOS. ADDED.	G.T.				

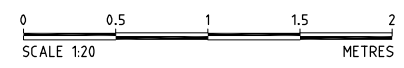
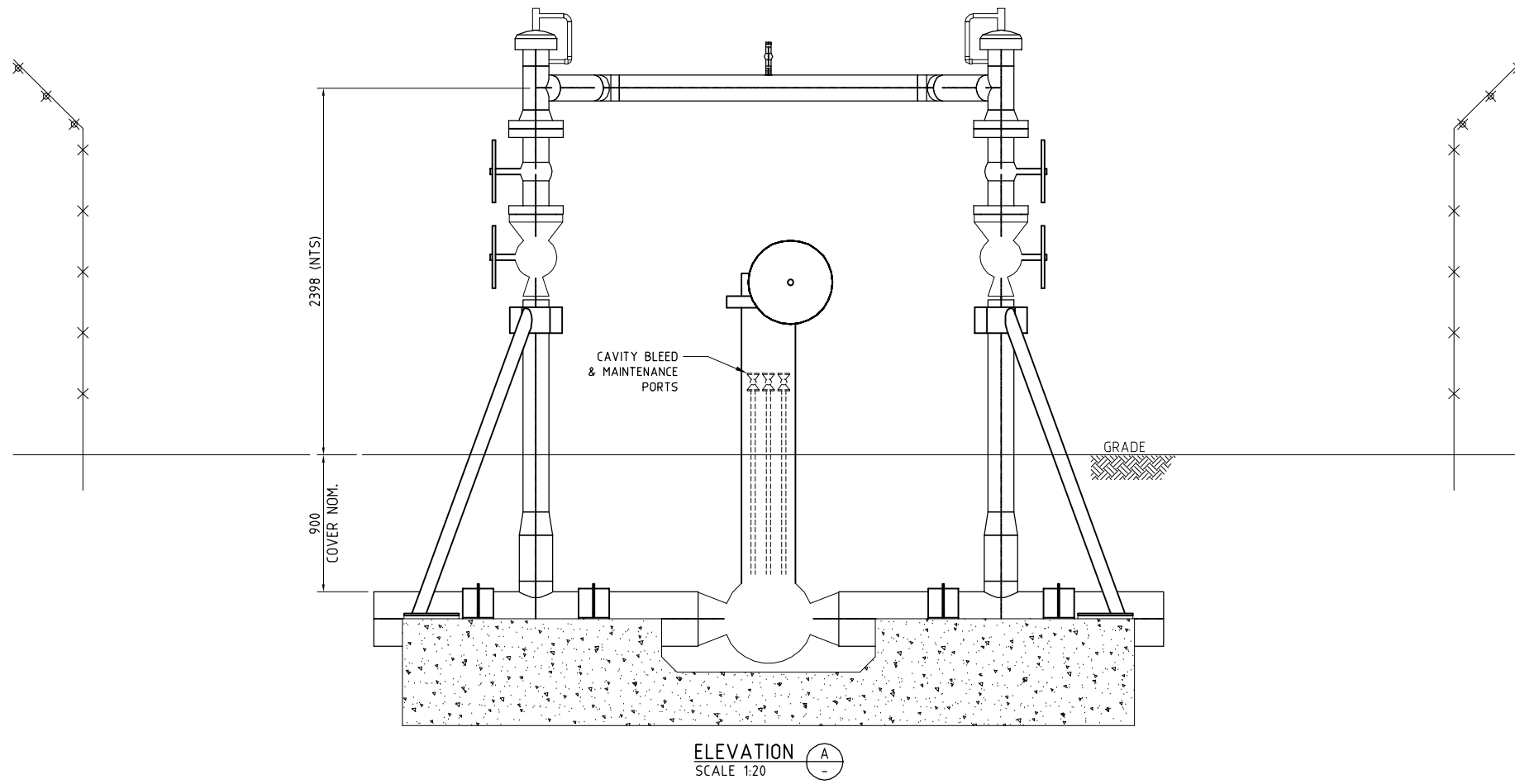
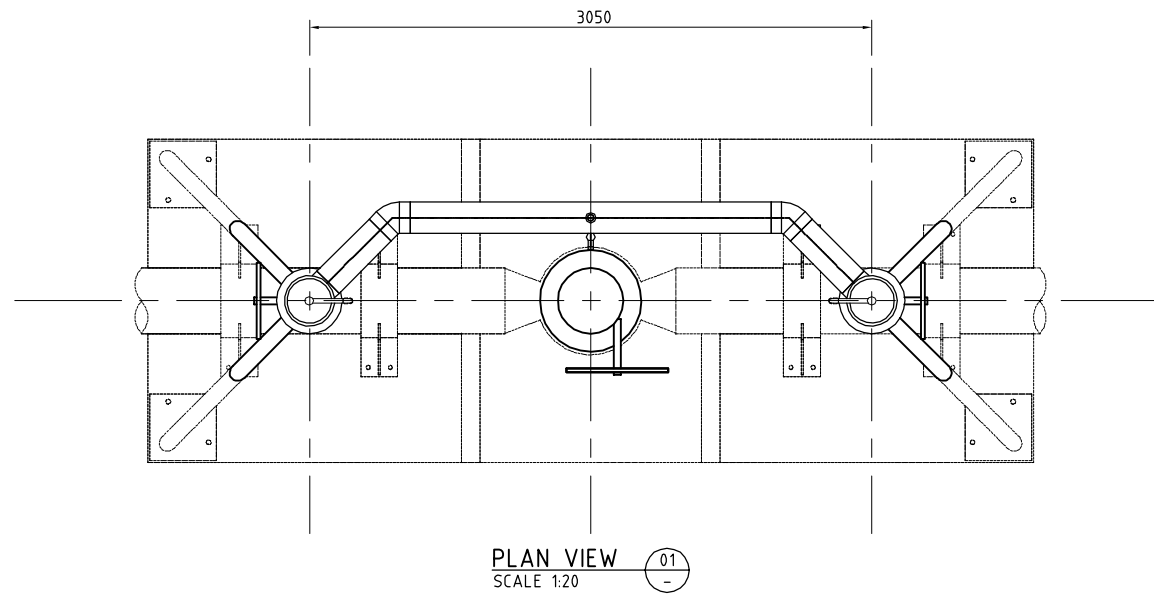
SCALE: SCALE 1:20, 1:10
JOB No.: 6850-000

NT GAS

AMADEUS BASIN TO DARWIN PIPELINE
MAINLINE VALVE ASSEMBLY km. 231
350 NS (900 COVER)

NUMBER	REV N
AD0231-6010	1

WILLIAMS BROTHERS SYDNEY
CMPS ENGINEERS N.S.W.



NOTES:
 1. REFER TO DRAWING AD0231-6010 FOR ALL PIPING DETAILS
 2. ALL DIMENSIONS ARE BASED ON 3D SCAN DATA. ALL 3D DATA RETAINED BY FYFE

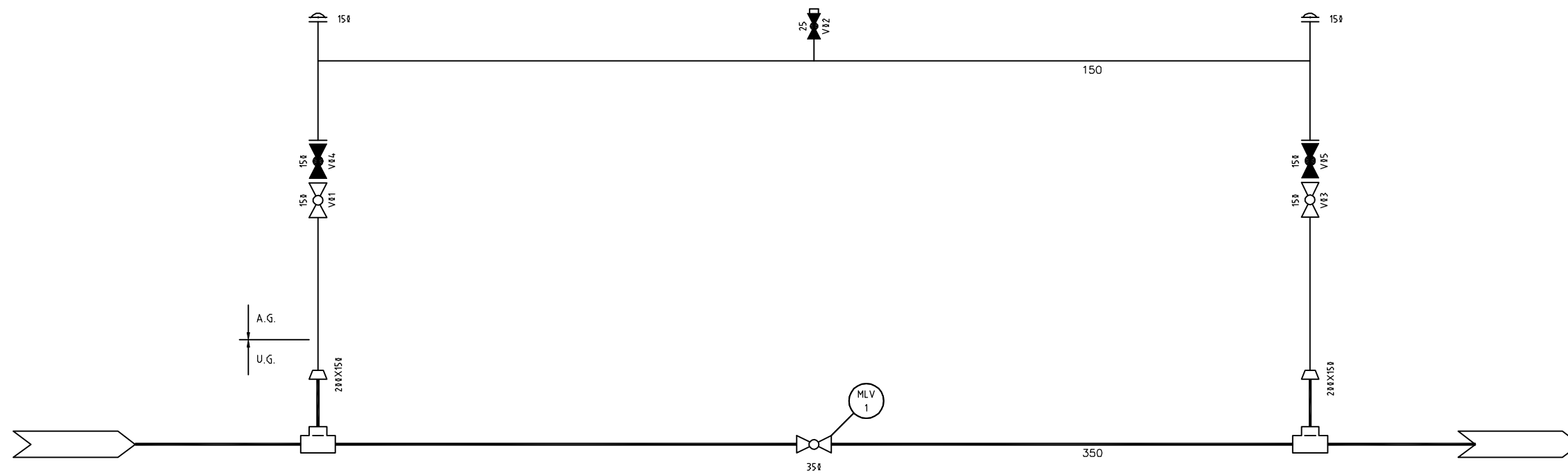
REV	REVISION DESCRIPTION	DATE	CHKD	INCHG	APP	REFERENCE DRAWING	ORIG
1							

FYFE Earth Partners
 ADVOK 112 100

FYFE
 Earth Partners
 100 W. 101st Street, Suite 100, Tulsa, OK 74107
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APA Group

SHEET NO.	SCALE	PROJECT	AMADEUS BASIN TO DARWIN PIPELINE
LEVEL DRAWING	PLAN/MAIN	TITLE	AILERON MAINLINE VALVE (350NS)
FIELD WORK	DATE	DATE	1/18/2024
	DATE	DATE	1/18/2024
	DATE	DATE	1/18/2024
PROJECT NO.	DRAWING NO.	REV	
	AD0231-6011	0	



ALL ANSI 600#



CHAINAGE	LOCATION
MLV-0241	AILERON
MLV-0401	BARROW CREEK
MLV-0547	KELLY WELL
MLV-0660	MORPHETT CREEK
MLV-0791	FERGUSSON
MLV-0935	DUNMARRA
MLV-1053	LARRIMAH

NOTES
1. ALL EQUIPMENT/INSTRUMENT TAG NUMBERS SHALL BE SUFFIXED WITH THE STATION NUMBER eg. MLV-1-XXXX.

DWG No.	REFERENCE DRAWINGS

No.	DATE	REVISION	BY	CHKD	ENG	ENG MGR	PROJ MGR	APP'D	No.	DATE	REVISION	BY	CHKD	ENG	ENG MGR	PROJ MGR	APP'D	
1	APR 19	ADDED LOCATION NAMES TO TABLE, UPDATED DISTANCES	BP	HD														
1	OCT 17	NEW DRAWING NUMBER, REFERENCE TO PREVIOUS DRG NO AD1111-713 REV 6	DCH	BP														

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CLIENT: N.T. GAS
TITLE: AMADEUS BASIN TO DARWIN PIPELINE
P & I DIAGRAM
TYPICAL 350 mm DIA. MAINLINE VALVE

DWG. No.	SCALE	JOB No.	DRAWING No.	REV.
B1	NTS	6850-000	AD TYP-7013	1

2 Hazardous Area Classification Report

This section contains the hazardous area classification report written for the Amadeus Basin to Darwin pipeline facilities.

AMADEUS BASIN TO DARWIN PIPELINE HAZARDOUS AREA CLASSIFICATION



FYFE REFERENCE: 18756-4-HAD-001

APA REFERENCE: HAD DATA REPOSITORY/ADP_18756_HADC

Prepared by:

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Principal Process Engineer - Fyfe

Date: 24-Nov-2011

Reviewed by:

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Manager, Mechanical Engineering - Fyfe

Date: 24-Nov-2011

Client Accepted:

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Pipeline Engineer – APA Group

Date:

Manager:

Henry Dupal
Engineering Manager – APA Group Northern Territory

Date:

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Revision History:

Rev.	Status	Date	Prepared	Reviewed	QA
A	Preliminary Issue	30/08/2010	YZW	TCB	
B	Revised to Incorporate Information from 2011 Part 1 Site Inspection	24/08/2011	TCB	RDK	
C	Revised to Incorporate Comments from Client	19/09/2011	TCB	RDK	
D	Revised to following 2011 Part 3 and Part 4 site inspections	26/09/2011	TCB	RDK	
E	Revised following 2011 Part 2 site inspections	10/10/2011	TCB	RDK	
0	Original Issue	24/11/2011	TCB	RDK	EZG

2.1 INTRODUCTION

2.1.1 OBJECTIVE

The hazardous area classification covers the above ground gas regulating and metering stations, scraper stations and mainline valves in the Northern Territory Gas Network.

The pipeline and facilities were originally constructed in 1985 with the additional facilities added to supply new users and supply points. No hazardous area documentation was completed at the time of the construction as there were no Australian Standards for hazardous area classification in 1985. The selection, installation and maintenance of electrical equipment were covered by AS 1076 series (1977).

This report documents the results of a Hazardous Area Classification undertaken for the facilities mentioned in Section 2.4.

The interpretation and application of this classification should take into account that Hazardous Area Classifications are inherently “imprecise” and involve assumption based estimates, code interpretation and engineering judgement.

2.1.2 SCOPE OF STATIONS

The scope of stations covered by this hazardous area classification is shown below:

Station	Description	KP
Palm Valley	Meter Station	0000
Palm Valley Alice Springs	Meter Station	0000
Mereenie	Meter Station	0000*
Tylers Pass	Transfer Station	0045
Tanami Road	Scraper Station	0161
Aileron	Mainline valve	0241
Ti Tree	Scraper Station	0316
Barrow Creek	Mainline Valve	0401
Wauchope	Scraper Station	0458
Kelly Well	Mainline Valve	0546
Tennant Creek	Meter Station	0025†
Warrego	Scraper Station ONLY	0610
Morphett Creek	Mainline Valve	0660
Renner Springs	Scraper Station	0733
Fergusson	Mainline Valve	0791
Elliott Meter Station	Meter Station	0003‡
Daly Waters	Meter Station	0982
Newcastle Waters	Scraper Station	0844
Katherine Offtake	Scraper Station	0000**
Katherine	Meter Station	0005**
Larrimah	Mainline Valve	1053
Mataranka	Scraper Station ONLY	1108
Tindal	Mainline Valve	1209
Helling	Scraper Station	1243
Pine Creek	Meter Station	1317
Ban Ban Springs	Scraper Station	1378
Batchelor	Mainline Valve	1441
Acacia	Mainline Valve	1465
Berry Springs	Mainline Valve	1486
Darwin City Gate	Meter Station	1498
Channel Island	Meter Station	1510

* On Mereenie to Tylers Pass Pipeline

** On ADP to Katherine Pipeline

† On ADP to Tennant Creek Pipeline

‡ On ADP to Elliott Pipeline

2.1.3 EXCLUSIONS

The following stations are excluded from this hazardous area classification

- Alice Springs facilities (owned and operated by Envestra),
- McArthur River Mine pipeline lateral facilities,
- Warrego compression facilities (scraper facilities are included),
- Tenant Creek offtake,
- Helling scraper station training pipework,
- Cosmo Howley facilities,
- Mt Todd facilities,
- Weddell facilities,
- Mataranka meter station.

The hazardous area classification does not consider the hazardous area associated with equipment not included in the pipeline licence, e.g. gas plants at Mereenie and Palm Valley, and the gas reticulation facilities at Darwin.

2.1.4 REVISION HISTORY

2.1.4.1 *Revision A*

The hazardous area classification was raised and issued following the inspection of four sites on the Amadeus Basin to Darwin Pipeline in 2010, as listed below:

- Darwin City Gate Station
- Channel Island Station
- Helling Scraper Station
- Pine Creek Station

2.1.4.2 *Revision B*

Further inspection of sites was undertaken in August 2011 and the hazardous area classification updated to incorporate sources of hazardous release from the equipment at these sites. The additional sites inspected were:

- Mereenie Station
- Palm Valley Meter Station
- Palm Valley Interconnect / Alice Springs Meter Station
- Tylers Pass Station
- Tanami Road Scraper Station
- Aileron Valve Site
- Ti Tree Scraper Station

2.1.4.3 *Revision C*

The hazardous area classification updated to incorporate comments and recommendations from APA.

2.1.4.4 *Revision D*

Further inspection of sites was undertaken in September 2011 and the hazardous area classification updated to incorporate sources of hazardous release from the equipment at these sites. The additional sites inspected were:

- Katherine Meter Station
- Mataranka Scraper Station
- Ban Ban Springs Scraper Station
- Batchelor Valve Site
- Berry Springs Valve Site

In addition there were some revisions to site descriptions for the stations included at revision to ensure consistency.

2.1.4.5 *Revision E*

Further inspection of sites was undertaken in October 2011 and the hazardous area classification updated to incorporate sources of hazardous release from the equipment at these sites. The additional sites inspected were:

- Wauchope Scraper Station
- Tennant Creek Meter Station
- Warrego Springs Scraper Station
- Renner Springs Scraper Station
- Elliott Meter Stations
- Newcastle Waters Scraper Station
- Daly Waters Meter Station

2.1.4.6 *Revision 0*

- Original Issue for use.

2.2 METHODOLOGY

This Hazardous Area Classification has been carried out in accordance with the “source-by-source” guidance taken from AS/NZS 60079.10.1 (Standards Association of Australia and New Zealand), in association with IP Code Part 15 (Institute of Petroleum – UK) and API RP 505 (American Petroleum Institute – USA).

The potential leaks that can be anticipated in both normal and abnormal operations have been considered, such as the failure of a valve gland and the partial failure of a gasket flange. The application of explosion proof (Ex) equipment will make sure that ignition does not take place. The classification does not allow for catastrophic failure of pipework or equipment where the associated mechanical effects are almost certain to cause ignition.

The extent of Zone 0, 1 and 2 areas has been identified by investigating each relevant source or type of source.

Due to the imprecision inherent in hazardous area classification, the designation of small non-hazardous area within larger hazard areas has been avoided.

Natural boundaries have been used to define zone limits where reasonably practical. In some cases, where believed adequate, this has reduced the assigned area to some extent. In other cases, where there is no economic disadvantage, the zone areas have been extended to simplify their arrangement.

The equipment and pipework in the stations are installed in open outdoor (all sides of the compounds are open and the stations are not installed in natural depressions), therefore they are considered adequately ventilated. This classification assumes that all stations on the ADP covered by this report are well maintained at all times.

2.3 REFERENCES

2.3.1 AUSTRALIAN STANDARDS

AS/NZS 60079.10.1:2009	Explosive atmospheres Part 10.1: Classification of areas – Explosive gas atmospheres (IEC 60079-10-1, Ed.1.0(2008) MOD)
AS/NZS 60079.20:2000	Electrical apparatus for explosive gas atmospheres Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus

2.3.2 INTERNATIONAL STANDARDS

IP 15 Third Edition, 2005	Model code of safe practice Part 15: Area classification code for installations handling flammable fluids
API RP 505 First Edition, 1997	Classification of locations for electrical installations at petroleum facilities classified as Class I, Zone 0, Zone 1, and Zone 2

2.4 PROCESS DESCRIPTION AND OPERATIONS

2.4.1 PROCESS DESCRIPTION

2.4.1.1 Overview

The Amadeus Darwin Pipeline (ADP) was constructed to deliver gas from the Palm Valley and Mereenie gas plants in the south of the Northern Territory to Darwin in the north of the territory. Several offtakes have been added to supply users along the length of the pipeline. The pipeline is approximately 1,513 km long.

Currently, the majority of the gas is supplied to the ADP from Wadeye via the Bonaparte pipeline. The Bonaparte pipeline connects in to the ADP at Ban Ban Springs.

Typically drains and vents in the facilities are fitted with plugs or caps and therefore are not a source of release during normal operation. Drains are operated only when then the pipeline is depressured and do not require further consideration, vent points marked with BD on the P&IDs are assumed to be operated during routine operation and maintenance of the station and require consideration as a source of release.

2.4.1.2 Mereenie

Gas to the Mereenie station comes from the Santos operated Mereenie gas plant. Currently there is no contract for the supply of gas from Mereenie, however the station remains pressurised and can be returned to operation if required.

The station consists of DN 200 above ground connection to the Mereenie gas plant. Close to the connection point are temperature and pressure transmitters and high temperature and pressure trips and a station limit valve (SLV). The SLV is pneumatically actuated from instrument gas conditioned locally. The instrument gas system is provided with a local PSV that vents to atmosphere.

The gas then passes to two parallel filter separators. The filter separators are horizontal and fitted with quick opening closures to allow removal of the filter elements. The filter separators have been swapped with the filters originally installed at Palm Valley and this required some pipework modifications. The liquids removed from the gas are collected in a drain boot underneath the filter separator. The liquids are drained back to the Mereenie production facility. The filter separators are fitted with the following instrumentation; pressure indicator, differential pressure transmitter, level glasses, high level switches and a PSV.

From each filter separator the gas flows to a meter run. The flow meters are orifice meters that are fitted with flow conditioners, pressure transmitter, a low range and a high range differential pressure transmitter and a temperature transmitter. A blowdown point is provided on each meter run that can blow down the meter run and filter separator.

The pipework downstream of each meter run joins to a common line. There is a DN 20 blowdown point and an insertion sample probe installed to provide gas samples for the gas chromatograph and dew point analyser.

The gas then passes underground through a manual station limit valve to the Mereenie to Tylers Pass pipeline. There is a scraper launcher installed with quick opening closure, pressure indicator, blow down vent and associated valving for the launching of pigs.

2.4.1.3 *Palm Valley*

The Palm Valley metering station receives gas from the Magellan Petroleum operated Palm Valley gas plant.

The station consists of DN 300 above ground connection to the Palm Valley gas plant. Close to the connection point are temperature and pressure transmitters and high value trips and a station limit valve (SLV). The SLV is pneumatically actuated from instrument gas conditioned locally. The instrument gas system is provided with a local PSV that vents to atmosphere.

The gas then passes to two parallel filter separators. The filter separators are horizontal and fitted with quick opening closures to allow removal of the filter elements. The filter separators have been swapped with the filters originally installed at Mereenie; the filters are installed in the same location and have required minimal pipework modifications. The liquids removed from the gas are collected in a drain boot underneath the filter separator. Liquids are removed to temporary containers. The filter separators are fitted with the following instrumentation; pressure indicator, differential pressure transmitter, level glasses, high level switches and a PSV.

From each filter separator the gas passes to a meter run. The flow meters are orifice meters that are fitted with flow conditioners, pressure transmitter, a low range and a high range differential pressure transmitter and a temperature transmitter. A blowdown point is provided on each meter run that can blow down the meter run and filter separator.

The pipework downstream of each meter run joins to a common line. There is a DN 20 blowdown point and an insertion sample probe installed to provide gas samples for the gas chromatograph and dew point analyser.

The gas then passes underground through a manual station limit valve to the Palm Valley to Tylers Pass pipeline. The underground section of pipe is fitted with a blowdown point. A connection point and additional valve has been installed on the blowdown stack to provide gas to the Palm Valley to Alice Springs station. The connection point for the gas analyser has been relocated to this section of pipework to allow measurement of the gas that passes from the Amadeus Darwin Pipeline to the Alice Springs Pipeline. The pipework to the Palm Valley to Alice Springs Pipeline passes underground to a point adjacent to the Palm Valley to Alice Springs compound. There is a flanged connection to the compound fence line.

There is a scraper launcher installed with quick opening closure, pressure indicator, blow down vent and associated valving for the launching of pigs to the ADP.

2.4.1.4 *Palm Valley Alice Springs*

The Palm Valley Alice Springs site, also referred to as the Palm Valley Interconnect receives gas from either the Magellan operated Palm Valley gas plant or from the ADP via the Palm Valley metering station.

The gas supply from the ADP is fed to a skid. The skid has recently been modified by APA, although no information is available. From the existing P&IDs and inspection; the pipe from the Palm Valley station is DN 100. The pipe decreases to DN 80 on the skid. At the inlet to the skid there is a pressure transmitter and indicator. The gas passes to a flow meter with pressure and temperature correction. Isolation valves and a manual bypass are provided. The skid is supplied with two pressure control valves, the main one is electro-pneumatic and the stand-by one is pneumatic controlled and actuated. Downstream of the control valves is an actuated valve fitted with pressure pilots and solenoids. The instrument gas for the control valves is conditioned from the transmission gas. The instrument gas is fitted with dual pressure regulators, knock out pot, filter, a PSV and high and low pressure pilots that close the actuated valve. The vents from all two valve instrument manifolds are tubed to a location at the edge of the skid roof.

The line from the Palm Valley gas plant is DN 100 which increases to DN 200. The gas then passes to a restriction orifice (RO). Upstream of the RO is the DN 50 kicker line connection to the scraper launcher. Downstream of the RO is the connection from the ADP. Next there is a station limit valve (SLV) that isolates Palm Valley to Alice Springs pipeline from both gas feeds. The SLV is pneumatically actuated from instrument gas conditioned locally and closes when a low pressure is sensed in the pipeline.

The scraper launcher is fitted with a quick opening closure, a pressure indicator, pressure relief valve and valves to allow operation.

Parallel to the scraper launcher is a wall. The wall is 1.8 m away from the centre line of the scraper launcher. The impact of the wall on the hazardous zones will be to extend the size of the hazardous area zone (refer section 2.7.12).

2.4.1.5 *Tylers Pass*

At Tylers Pass the gas from Mereenie and Palm Valley are commingled and odorant is added. The DN 250 pipeline from Mereenie passes to an above ground scraper receiver, fitted with pig sig, vent, pressure indicator, quick opening closure and valving to allow operation. During normal operation the gas bypasses the scraper vessel via underground pipework. A pipeline riser is fitted with pressure transmitter, pressure indicator and high pressure trip. Downstream, there is a buried valve with above ground pneumatic actuator. The actuator is powered by instrument gas conditioned locally from the transmission gas.

The gas from Palm Valley is similar to the Mereenie connection but does not have a scraper receiver. The pipeline is DN 350 and includes a riser with pressure transmitter and pressure indicator upstream of a buried valve with above ground pneumatic actuator. The actuator is powered by instrument gas conditioned locally from the transmission gas.

There is a DN 200 vertical blowdown stack fitted with quick opening closure. The stack has buried connections and valves to the pipeline sections to Mereenie, Palm Valley and Tanami Road, as well as the scraper receiver.

Downstream of the two actuated valves the two pipeline sections join and are fitted with a temperature transmitter, pressure transmitter, pressure indicator, instrument gas offtake and odorant injection point.

The odorant injection package consists of an odorant storage pressure vessel, instrument gas conditioning and control and odorant dosing pumps. The storage vessel is fitted with a pressure relief valve, pressure indicator, two level glasses, a level transmitter and a continuous vent fitted with adsorption vapour filter. The vent from the tank is fitted with a cap so that the discharge point is vertically downwards. The instrument gas conditioning equipment comprises two regulators to reduce the pressure to 400 kPag. The tank blanket instrument gas is regulated to 15 kPag by a pressure regulator / over pressure shut off (OPSO) valve. The injection pump instrument gas is regulated to 400 kPag by a regulator. Control of the odorant injection pumps is by solenoid valves. The odorant dosing pumps suction is connected to the bottom of the odorant storage vessel. The discharge of each odorant dosing pump is fitted with a flow switch and pressure relief valve. The odorant injection point is fitted with an averaging chamber and a site flow indicator.

Note that there is no gas supply from Mereenie or Palm Valley and the gas flow through Tylers Pass is in the reverse direction. At the time of inspection the odorant plant was not operating.

2.4.1.6 *Tennant Creek Metering Station*

The Tennant Creek pressure reduction and metering station receives gas from ADP to Tennant Creek Pipeline, approximately 25 km long, and supplies the Tennant Creek power generation site. The Tennant Creek Station comprises of two filter separators, two water bath heaters, an atmospheric slop tank, control valves, pressure regulators, pressure relief valves, and the related pipework, instrumentation and valving.

The inlet to the station is DN 100 and consists of a scraper receiver vessel. The scraper vessel is fitted with local vent, PSV, pressure indicator and associated pipework and valving. The closure on the vessel is a blind flange.

The piping in parallel to the scraper receiver is fitted with a pressure transmitter, pressure gauge and a buried mainline valve. The valve has an aboveground gas over oil hydraulic actuator.

The gas then passes through two parallel filter separators. Upstream of both filter separators are temperature control valves that reduce the pressure to 5,200 kPag / 17°C [based on operating conditions at the time of the site visit]. The temperature control valves are provided with cascade control for pressure and temperature. The filter separators are fitted with a differential pressure transmitter, pressure indicator, high liquid level switches and high-high liquid level switches. The liquids are drained manually to an elevated slops tank. The slop tank is fitted with a liquid level glass and hose to allow emptying.

Gas from the filter separators is then heated by indirect fired water bath heaters to approximately 60 °C. The water bath heaters are operated as duty - standby, with the standby heater remaining 'hot' to allow quick change over, controlled by the actuated valves on the inlet to each heater.

The heated gases from heaters pass through two parallel regulator / meter runs. The regulator / meter runs are operated in duty - standby and each contains active - monitor pressure regulators. The meter skids are provided with two actuated valves that close on high pressure downstream of the regulators. Additional high pressure switches at the station outlet initiate a station ESD. Further over pressure protection is provided by a PSV at the station outlet. A meter is provided in each run. The meters are orifice meters with upstream flow conditioners, temperature transmitters, pressure transmitters and high and low range differential pressure transmitters. Each run is provided with a local blowdown point, pressure indicators and valving.

The station outlet is provided with a temperature indicator, temperature transmitter and low temperature switches. There is also provision for the installation of a future gas sampler. The connection to the Tennant Creek power generation site is DN 100.

Pipework downstream of the heater is fitted with insulation up to the station outlet.

Instrument gas is conditioned locally for each actuated valve and temperature control valve. Gas is conditioned at each water bath heater to provide fuel gas for the pilot and main burners. The fuel gas conditioning trains comprise of a pre-heat coil, strainer, primary pressure regulating valve, actuated ESD valves, secondary pressure regulating valve, meter and a temperature control valve.

A control system provides control and telemetry for the various process measurement parameters. The control system provides flow control and high pressure automatic shutdown functionality and allows remote operator shutdown. The control system is powered by single phase 230 VAC power supply, with back up batteries.

2.4.1.7 *Elliott Meter Station*

The Elliott Meter Station receives gas from a DN 50 lateral from the ADP. The lateral is approximately 4 km long and provides gas for the Elliott power generation site. The station consists of a scraper receiving vessel, dry gas filter, filter separator, knock out pot, two stages of pressure regulation, a catalytic heater, metering run, slop tank, atmospheric vent stack and the associated pipework, valves and instrumentation.

At the inlet to the station is a scraper receiving vessel. The scraper vessel is fitted with local vent, PSV, pressure indicator and associated pipework and valving. The closure on the vessel is a blind flange.

The main gas flow to the skid passes to an actuated valve. The gas is then filtered in a dry gas filter. The filter is horizontal and fitted with a quick opening closure, differential pressure gauge, PSV and vent.

The gas then passes to a temperature gauge and then two parallel pressure regulators that operate in duty and standby that reduce the gas pressure to 3,000 kPag.

The gas passes to a filter separator fitted with a differential pressure gauge with inductive high differential pressure switch, level gauge, pneumatic liquid level controller and control valve and high liquid level switch, pressure relief valve.

The gas from the filter separator passes to a knock out pot and then to a catalytic heater. The catalytic heater is decommissioned and has not operated for some time.

From the heater the gas passes to the second stage pressure regulators. The gas is reduced in pressure to 500 kPag in the parallel pressure regulators, operating in a duty-standby arrangement.

The gas is then metered in a rotary positive displacement meter that is corrected for temperature and pressure. Upstream of the meter is a second pressure relief valve.

Instrument gas for the site instrumentation and fuel gas for the catalytic heater are conditioned in an offtake from the outlet of the skid and distributed as required.

A control system provides control and telemetry for the various process measurement parameters. The control system provides flow control and high pressure automatic shutdown functionality and allows remote operator shutdown. The control system is powered by single phase 230 VAC power supply, with back up batteries.

2.4.1.8 *Daly Waters Scraper and Meter Station*

The Daly Waters Scraper and Meter Station is located at KP 0982 on the ADP and consists of a scraper receiver, scraper launcher and a filter, meter and pressure regulator station. The scraper part of the station is on the ADP and is the same as the scraper stations described in section 2.4.14. The meter part of station provides filtration and metering for the McArthur Mine River Pipeline. The meter station consists of gas over oil hydraulically actuated mainline, filter separators, metering, pressure regulation, a scraper launcher and associated pipework, valving and instrumentation.

The connection to the meter station is from the underground future compressor connection on the southern side (nominally upstream) of the scraper station. An above ground DN 350 blank flange has been provided for future connections. The connection to the meter station is DN 150 and consists of a ball valve with pressurising bypass and a downstream blank flange. The connection to the meter skid is by approximately 50 m of DN 150 welded pipe across the station.

The metering station is installed on two skid frames. The first comprises of an actuated valve, two dry gas filters, two meters, pressure control valves, instrument gas conditioning system and a scraper launcher.

The actuated valve is gas over oil actuated. Downstream of the actuated valve are two dry gas filters. Each dry gas filter is fitted with a differential pressure transmitter, manual vent and a drain. The gas from each filter passes to a meter run that comprises of a flow conditioner, orifice plate and thermowells. One of the meter runs is not fitted with instruments. The other is fitted with pressure transmitter, differential pressure transmitter and temperature transmitter.

2.4.1.9 *Katherine Offtake*

The Katherine Offtake is installed on the ADP at approximately KP 1,221. The site consists of a take-off from the mainline. The offtake is fitted with a DN 100 buried valve. The valve is manual operated and has above ground gear box, maintenance ports and a cavity bleed. The valve has DN 50 risers either side of the valve, fitted with manual valves. A scraper launcher is installed at the site. The scraper vessel is fitted with pressure indicator, PSV and local vent. An above ground DN 100 valve with DN 50 bypass is also provided at the station. The valve may be a plug valve, a ball valve or a globe valve in accordance with the P&ID, details drawing or site photographs respectively.

2.4.1.10 *Katherine Meter / Regulating Station*

The Katherine Meter/Regulating Station includes two filter separator, two water bath heaters, a slop tank, main line valve, control valves, pressure relief valves and the related pipework, instrumentation and valving.

The inlet to the station is DN 100 and consists of a buried station limit valve (MLV 11) with above ground actuator, maintenance ports and cavity bleed. A scraper receiver vessel is installed in parallel to MLV 11. The scraper vessel is fitted with a local vent, PSV, pressure indicator and associated pipework and valving. The closure on the vessel is a blind flange.

The following instrumentation is installed at the inlet; pressure indicator, a pressure transmitter and a temperature indicator.

The gas then passes through two parallel filter separators. Upstream of both filter separators are temperature control valves that reduce the pressure to 4,400 kPag / 16°C [based on operating conditions at the site visit]. The temperature control valves are provided with cascade control for pressure and temperature. One valve is fitted with a pneumatic controller to continue supply during outage of the electronic control system. The filter separators are fitted with differential pressure transmitter, pressure indicator, high liquid level switches and high-high liquid level switches. The liquids are drained manually to an elevated slops tank. The slop tank is fitted with a liquid level glass and a hose to allow emptying. Gas from filter separators is then heated by indirect fired water bath heaters up to approximately 60 °C. The water bath heaters are operated as duty - standby, with the standby heater remaining 'hot' to allow quick change over of the that is controlled by actuated valves on the inlet to each heater.

The heated gases from the heaters pass through two parallel regulator / meter runs. The regulator / meter runs are operated in duty - standby and each contains active - monitor pressure regulators. The meter skids are provided with two actuated valves that close on high pressure downstream of the regulators. Additional high pressure switches at the station outlet provide a station ESD. Further over pressure protection is provided by a PSV at the station outlet. A meter is provided in each run. The meters are orifice meters with upstream flow conditioners, temperature transmitters, pressure transmitters and high and low range differential pressure transmitters. Each run is provided with a local blowdown point, pressure indicators and valving.

The station outlet is provided with a temperature indicator, temperature transmitter and low temperature switches. There is also provision for the installation of a future gas sampler. The connection to the Katherine power generation site is DN 100.

Instrument gas is conditioned locally for each actuated valve and temperature control valve. Gas is conditioned at each water bath heater to provide fuel gas for the pilot and main burners. The fuel gas conditioning trains comprise of pre-heat coil, strainer, primary pressure regulating valve, actuated ESD valves, secondary pressure regulating valve, meter and temperature control valve.

The gas released in emergency directs to the vent stack that discharges to atmosphere and the liquid removed from the gas flows to the slop tank. The maximum PSV set point is 3,200 kPag and the temperature limit is set at 60 °C in the station.

A control system provides control and telemetry for the various process measurement parameters. The control system provides flow control and high pressure automatic shutdown functionality and allows remote operator shutdown. The control system is powered by single phase 230 VAC power supply, with back up batteries.

2.4.1.11 Pine Creek

The Pine Creek pressure reduction and metering station receives gas from ADP to supply the Pine Creek power generation site. The Pine Creek Station comprises of a dry gas filter vessel, a filter separator, a knockout pot, two water bath heaters, an atmospheric slop tank, control valves, pressure relief valves, and the related pipework, instrumentation and valving.

The Pine Creek station is located close to the ADP and a mainline valve is located within the station. The inlet connection to the station has two DN 80 manual valves. One valve is fitted with an insulation flange and a surge arrestor, the second is fitted with a pressurising bypass. Downstream of the manual valves is an actuated valve that is also fitted with a pressurising bypass. The gas then passes to a dry filter vessel that is fitted with a pressure indicator, PSV, a vent valve, pressurising line and a bypass line to allow maintenance of the filter. From the filter, the gas passes to a duty standby temperature control valve that drops the gas pressure from 7,800 to 4,200 kPag and a temperature of 16°C [based on observations during the site visit]. The gas then passes to a filter separator that is fitted with level gauge, level controller, level control valve, high level switch, pressure indicator, PSV, vent valve and differential pressure transmitter. In parallel to the filter separator is a knock out pot to allow maintenance on the filter separator. The knock out pot is fitted with level gauge, pressure indicator, PSV, vent valve and drain valve.

Gas from filter separator / knock out pot is then heated by indirect fired water bath heaters up to approximately 60 °C. The water bath heaters are operated as duty - standby, with the standby heater remaining "hot" to allow quick change over of the that is controlled by actuated valves on the inlet to each heater.

The heated gas then passes to parallel pressure control valves. The valves are operated as duty and standby. The valves are pneumatically controlled. Over pressure protection is provided by a PSV downstream of the pressure control valves. Gas metering is by a single orifice meter fitted with a pressure transmitter; high and low range differential pressure transmitters and a temperature transmitter. A bypass is provided around the meter for maintenance.

Metered gas then passes to a second knock out pot fitted with a drain valve, PSV and level gauge. The piping from the knock out pot contains a temperature transmitter, temperature indicator, high pressure switches and a pressure transmitter. A double block and bleed valving arrangement is provided. The connection to the Pine Creek power generation site is via an underground pipework and the above ground flange is provided with an insulation

gasket. A spare flange is provided at the connection point for a future connection to the Pine Creek power generation site, the flange is fitted with a blind flange, insulation gasket and a surge arrestor.

Liquids collected from the dry filter, filter separator and knock out pots is sent to an elevated slops tank. The slops tank is fitted with a safety relief valve (SRV), pressure vacuum vent valve, flame arrestor, pressure indicator, high liquid level switch and hose for emptying.

Vents and PSV discharges from the dry filter, filter separator and knock out pots and vents from instrument manifolds and pneumatic controllers are sent to a local vent stack. The vent stack is fitted with a flame arrestor.

Instrument gas is conditioned centrally for the site from a connection from the outlet knock out pot.

Gas is conditioned at each water bath heater to provide fuel gas for the pilot and main burners. The fuel gas conditioning trains comprise of pre-heat coil, strainer, primary pressure regulating valve, actuated ESD valves, secondary pressure regulating valve, meter and temperature control valve. A control system provides control and telemetry for the various process measurement parameters. The control system provides flow control and high pressure automatic shutdown functionality and allows remote operator shutdown. The control system is powered by single phase 230 VAC power supply, with back up batteries.

2.4.1.12 Darwin City Gate

Darwin City Gate receives gas from the ADP. Gas flows to three locations, Wickham Point, Channel Island and Trunk Package Offtake Station (TPOTS). The Wickham Point (Corroco Philips, Darwin LNG plant) pipeline can be reversed to ensure gas supply to Darwin/Channel Island. The gas supply to Wickham point is fitted with an actuated valve. The gas supply to Channel Island and TPOTS is filtered, reduced in pressure to 5,800 kPag and the gas composition and moisture dew point is analysed. The gas to TPOTS is regulated to a 850 kPag and metered.

The Darwin City Gate Station comprises of scraper vessels, a multicyclone, two filter separators, an atmospheric slop tank, gas chromatograph system, moisture analyser, control valves, pressure regulator, pressure relief valves, blowdown stack and the related pipework. Liquids (condensate, water and compressor lube oil) removed from the gas is stored in the slop tank for batch treatment.

The station consists of DN 300 above ground connection. A scraper receiver is installed with buried hydraulically actuated valve. The actuated valve includes electric solenoids to allow remote operation. During normal operation gas bypasses the scrapers and flows through the actuated valve, the scraper vessels are closed and isolated from the pipeline. At the station inlet, the pipeline divides in two, with one supplying gas to Weddell interconnect and one supplying to the City Gate station. The main line is installed with DN20 blowdown, temperature transmitter and pressure transmitter. The line then divides in two, the normal flow is through the multi-cyclone to remove solids. The multicyclone is fitted with a PSV with a set point of 9,650 kPag. Both parallel streams include a temperature control valve and a filter separator. The filter separators are horizontal and fitted with quick opening closures to allow removal of the filter elements. The liquids removed from the gas are collected in a drain boot underneath the filter separator and flow under level control to a slop tank. The filter separators are fitted with the following instrumentation and connections; pressure indicator, differential pressure transmitter, level glasses, high level switches, high high level switches, local drains and level controllers. The

temperature and level control valves are pneumatically controlled and actuated. Local instrument gas conditioning skid is provided with PSV to provide over pressure protection.

Common line of the outlet from the filter separators is installed with temperature indicators, temperature transmitter, pressure indicators, and pressure transmitters. The connection point for the gas chromatograph and dew point analyser has been installed to this section of pipework to allow analysis of the gas. The gas chromatograph and dew point analyser are installed in a shelter adjacent to the filter skid. The chromatograph receives a sample of the transmission gas at a pressure of approximately 140 kPag from an insertion regulator installed in the pipe. The carrier and calibration gases are stored in gas bottles and regulated for use at 140 kPag. The chromatograph vents gas to exhaust vents above the analyser shelter roof. The mainline then passes through a mainline valve. Downstream of the mainline valve is installed with pressure indicator and transmitter before the pipeline directed to Channel Island meter station.

A separate offtake to TPOTS passes gas to a DN 50 pressure regulation and metering skid. The skid has duty and standby arrangement with each containing active and monitor pressure regulators and turbine meters. A high pressure trip is provided that closes an actuated valve at the inlet. The meter runs, with one serving as duty run and other as standby run. The gas is then directed to Berrimah Road.

A control system provides measurement and telemetry for the various process instruments. The control system allows remote operator shutdown. The control system is powered by single phase 230 VAC power supply, with back up batteries.

2.4.1.13 Channel Island

Channel Island regulating and metering station receives gas from Darwin City Gate meter station. The Channel Island Regulating Meter Station consists of two water bath heaters, solids filter, four filter separators, slam shut valves, active and monitor regulators, meters, pressure relief valves, local vent points and the associated valving and pipework.

The gas passes to a solids filter. The filter is fitted with a pressure indicator, differential pressure transmitter, local vent point and local drain. The filter has a quick opening closure and a bypass, with manual valving. The filtered gas is then heated to approximately 60°C in two parallel water bath heaters. One water bath heater is operating and the other is in hot-standby. Actuated valves at the heater inlets control the gas flow.

The combined outlet line from the water heaters as a high temperature switch, temperature indicator and temperature transmitter. The line then passes to one of two filter, regulation and metering runs to supply gas to either Unit 1 or Unit 7 at the Channel Island Power Generation Site.

The Unit 1 filter, regulation and metering run comprises of two parallel runs each containing actuated valve, active-monitor pressure regulators, filter separators and meters. The actuated valves are both normally open and are closed on either signal from the control system or high pressure downstream of the regulators. The pressure regulators are self acting and externally sensed. The gas of each regulator pair flows to the corresponding filter separator. The filter separators are horizontal and fitted with quick opening closures to allow removal of the filter elements. The liquids removed from the gas are collected in a drain boot underneath the filter separator. No slops tank is installed at site at liquids are drained from the filter separators manually. The filter separators are fitted with the following instrumentation and connections; pressure indicator, differential pressure transmitter, level glasses, high-high level switches, local drains and level controllers. The filtered gas is metered in orifice meters, each meter is fitted with flow conditioner, pressure transmitter, high and low range differential pressure transmitters and temperature transmitters. Additional overpressure protection is provided by a PSV. The combined outlet from the Unit

1 regulation, filter and metering runs is fitted with low pressure switch and high pressure switches that all initiate an ESD, and a pressure transmitter, pressure indicator, temperature transmitter, temperature indicator, low temperature switch connection for future gas analysis and an isolation valve.

The Unit 7 filter, regulation and metering run comprises of two parallel runs each consisting of filter separator, pressure regulators, metering and associated instrumentation and valving. There is an actuated valve at the inlet before a split to two filters. The filters are fitted with pressure indicator and differential pressure transmitter. Downstream of each filter is an actuated valve. The valves are normally open and are closed on signal from the control system or high pressure downstream of the pressure regulators. Metering is provided by a Coriolis meter and a AVT turbine meter. The primary duty meter is the Coriolis meter, but the turbine meter can be operated in series or parallel. Both meters are provided with temperature and pressure correction. Downstream of the meters the combined outlet has a PSV, local manual vent, temperature transmitter and pressure transmitter.

Instrument gas is conditioned locally for each actuated valve.

A control system provides measurement and telemetry for the various process instruments. The control system allows remote operator shutdown. The control system is powered by single phase 230 VAC power supply, with back up batteries.

2.4.1.14 *Scraper Stations*

The scraper stations are provided along the length of the pipeline to allow cleaning and inspection of the pipeline. The scrapers stations are installed at Tanami Road, Ti Tree, Wauchope, Renner Springs, Newcastle Waters, Helling and Ban Ban Springs. Additionally scraper vessels are included at some of the stations along the pipeline. A scraper receiver and launcher are installed at each site along with a buried hydraulically actuated valve. The actuated valve includes electric solenoids to allow remote operation. During normal operation gas bypasses the scrapers and flows through the actuated valve, the scraper vessels are closed, isolated from the pipeline and depressured.

The pipeline is provided with buried isolation valves. A pressure transmitter and indicator are installed on a pipe riser either side of the actuated valve. A temperature transmitter is installed downstream of the actuated valve.

The scraper vessels are fitted with quick opening closures, a DN 25 local vent, a pressure gauge and connections with valves to allow operation. The vessels also include connections for pressure relief valves that have been removed on some / all scraper vessels. Pig passage indicators are installed on the pipeline and scraper vessels.

There is also a pipeline vent installed at the site within a separate compound. During normal operation the vent is closed with a quick opening closure.

2.4.1.15 *Ban Ban Springs Scraper Station*

The scraper station at Ban Ban Springs also includes an off take connection to Cosmo-Howley and a supply connection from the Wadeye pipeline. The off take to Cosmo Howley is a blind flange on a pipeline riser. The pipeline is decommissioned and the meter station has been removed. The connection from the Wadeye pipeline is underground pipework from the Ban Ban Springs meter station. The pipeline connections is to the upstream connection for a future compressor. There is an above ground valve with bypass installed adjacent to the connection.

At the Helling scraper station there are pipework and vents that are used for training. The training pipework is not connected to the station pipework during normal operation of the pipeline and the training pipework is unpressurised. No records have been provided for the training pipework and it is not included in the hazardous area classification.

2.4.1.16 Warrego Scraper Station

The scraper station at Warrego is also the site of a compressor. The compressor is connected to underground connections either side of the mainline valve. An actuated valve with manual bypass / pressuring line is installed at each connection. The actuated valves are provided with an instrument gas connection from the Warrego compressor site.

The remainder of the Warrego compressor site is not considered within this hazardous area classification.

2.4.1.17 Mainline Valves

There are several mainline valve sites located at Aileron, Barrow Creek, Kelly Well, Morphett Creek, Fergusson, Larrimah, Tindal, Acacia and Berry Springs. The data used for classifying the mainline valves' hazardous area is obtained solely from the Aileron site. Each of the sites is assumed to be identical and comprises of a buried valve with an above ground bypass and vent points with no instrumentation installed on the mainline valve. The buried valve has a manual actuator and gear box, injection ports and cavity bleed extended above ground. This is shown in the photograph below.



2.4.1.18 Bachelor Mainline Valve

The Bachelor mainline valve site is located at KP 1441 between Ban Ban Springs and Darwin City Gate. The Bachelor Mainline valve site is similar to other mainline valve sites but the mainline valve has an actuator, similar to the scraper stations. The mainline valve consists of a DN300 underground valve with an above ground actuator, maintenance ports and cavity bleed. The valve has an above ground DN100 bypass. Pressure transmitters are fitted either side of the valve. The site also has a control room.

2.4.2 OPERATING CONDITIONS

The maximum operating pressures and temperatures at the stations are summarised in Table 1.

Table 1 Operating pressures and temperatures

Temperature	Pressure (Process)	Pressure (Fuel gas)	Pressure (Instrument gas)
Max. (°C)	Max. (kPag)	Max. (kPag)	Max. (kPag)
60	9,650	≤ 650	770

2.4.3 VENTILATION

Each of the sites is in the open air and is considered to have good ventilation. Some equipment is installed in open-sided shelters. These are not considered to have any impact on ventilation.

2.5 PROPERTIES OF HAZARDOUS MATERIALS

2.5.1 GASES HANDLED

The gas processed through the regulating and metering stations contains mainly methane (typically 87 mol%) and nitrogen (about 8 mol%), along with small quantities of hydrocarbons (C2+) and carbon dioxide (totally < 5 mol%). The specific gravity of the gas is 0.62, which is lighter than air (SG=1.0). It is classified as a Category G(i) fluid in accordance with IP15 Section 1 (Table 1.2 – fluid categories) and as a Group IIA in accordance to AS/NZS 60079.20 section 4.6. The composition of the gas is shown in Table 2.

Note that the gas composition in the pipeline can vary from the typical figures shown in Table 2. However, methane will remain the predominant component and the properties of the gas will remain the same and will be the same as methane. Australian standard AS 4564 (AG 865) Specification for general purpose natural gas, provides information of the allowable properties of natural gas. Similarly, APA will have a Sales / Shipping Agreement for the injection of gas into the pipeline that should be observed. The limitations are summarised in Table 3.

Note that on release from high pressure, the gas will be cooled due to Joule-Thomson cooling. At lower temperatures the gas is less dense and the dispersion in air will be slightly impacted, but the flammable range is reduced. Similarly, for higher temperatures the flammable range is increased, but the dispersion is increased. At the dilute concentrations at the lower explosive limit, the gas-air mixture temperature will be close to ambient temperature therefore, there will be no additional consideration for temperature effects.

Table 2 Typical Gas Composition

Component	Symbol	mol%
Methane	CH ₄	87.0
Ethane	C ₂ H ₆	2.6
Propane	C ₃ H ₈	0.8
i-Butane	C ₄ H ₁₀	0.1
n-Butane	C ₄ H ₁₀	0.2
i-Pentane	C ₅ H ₁₂	0.07
n-Pentane	C ₅ H ₁₂	0.05
n-Hexane	C ₆ H ₁₄	0.07
n-Heptane	C ₇ H ₁₆	0.02
n-Octane	C ₈ H ₁₈	0.004
n-Nonane	C ₉ H ₂₀	0.004
Carbon Dioxide	CO ₂	0.95
Nitrogen	N ₂	8.2
Total		100
Specific Gravity (mixture)		0.62

Table 3 Gas specification limits

Characteristic	APA Schedule 4 Limits	AS 5654 Limits
HHV	Minimum 33.0 MJ/Sm ³ Maximum 42.0 MJ/Sm ³	-
Wobbe Index	Minimum 44.0 MJ/Sm ³ Maximum 51.0 MJ/Sm ³	Minimum 46.0 MJ/m ³ Maximum 52.0 MJ/m ³
Oxygen	Maximum 0.2 mol%	Maximum 0.2 mol%
Hydrogen Sulphide	Maximum 10.0 ppmw	Maximum 5.7 mg/m ³
Total Sulphur	Maximum 50 mg/Sm ³	Maximum 50 mg/m ³
Water Content	Maximum 80 mg/Sm ³	Maximum – Dewpoint 0°C at the highest MAOP in the relevant transmission system (in any case, no more than 112.0 mg/m ³)
Cricondentherm	Maximum 10.0°C	
Hydrocarbon Dewpoint		Maximum 2.0°C at 3,500 kPa
Total inert gases	Maximum 12.0 mol%	Maximum 7.0 mol%
Nitrogen	Maximum 11.0 mol%	-
CO ₂	Maximum 7.5 mol%	-
Mercury	Maximum 0.2 mg/Sm ³	
Methanol	Maximum 1.0 mg/Sm ³	
Glycols	Maximum 1.0 mg/Sm ³	
Radioactivity	Maximum 8,000 Bq/Sm ³	
Notes		m ³ refers to dry gas at standard conditions (15°C and 101.325 kPa)

The chromatograph used for gas composition analysis requires carrier and calibration gases. The carrier gas (helium) is not flammable, while the calibration gas (mainly methane) is classified as a Category G(i) fluid with similar compositions as process gas.

2.5.2 LIQUIDS HANDLED

2.5.2.1 *Filter Separator Drains*

The liquids handled at the facilities may consists of condensate, compressor lubrication oil or water, which is removed from the gas by the filter separators. The condensate is considered to be flammable liquid and based on hexane is considered to be a group IIA liquid in accordance to AS/NZS 60079.20. The compressor lube oil used in the stations is combustible, but not flammable, with a typical flash point (closed cup) over 60 °C. Therefore, it is treated as a non-hazardous material for the purpose of the hazardous area classification. Water is considered to be non-hazardous liquid.

2.5.2.2 *Odorant*

Odorant is injected into the pipeline at Tylers Pass. The odorant is SpotLeak 1005 and is a flammable liquid. It consists of Thiophene, Propanethiol and methyl as per the product specification. The odorant is classified as group IIA in accordance to AS/NZS 60079.20 and category C fluid in accordance with IP15 Section 1 (Table 1.2 – fluid categories).

2.6 EQUIPMENT SELECTION

The general requirements for selection, installation and maintenance of explosion proof (Ex) electrical equipment are described in AS/NZS 2381.1:2005.

To ensure the Ex electrical equipment performs satisfactorily, without the risk of ignition, the data shown in Table 3 must be used as area specification requirements.

Table 4 Gas Group and Temperature Class

Performance Criterion	Requirement	Reference
Ambient temperature	0 - 50 °C	Bureau of Meteorology
Auto-ignition temperature (Methane)	537 °C	AS/NZS 60079.20
Apparatus Group	IIA	AS/NZS 60079.20
Temperature Class	T1 / T3	AS/NZS 60079.20

The recommendations on equipment group and temperature class should be regarded as **minimum** requirements. Equipment selection must take into account local conditions, such as the presence of hot surfaces close by and electrical equipment design.

2.7 CLASSIFICATION

2.7.1 PIPING

2.7.1.1 Process Piping

Welded piping at the stations is designed and constructed to ANSI/ASME B 31.3 and is not considered as a source of release. However, the possible release of flammable material occurs at flanges, valves and fittings due to the possible leakage from a gasket or seal. A majority of process gas service pipework installed in the stations is flanged. The screwed connections are limited to the small bore piping with a nominal size less than DN25. The screwed piping has tapered threads with similar leakage integrity to the flanged connections. The piping in the facilities is a permanent fixture and not subject to vibration.

All flanges and infrequently used valves are considered to be well maintained and located in an adequately ventilated area in the gas regulating and metering stations. Leakage of the flammable material at connection points is considered abnormal and the quantity of the hazardous material released is considered minor. Consequently, they are regarded as sources of *Secondary* grade release and a hazardous Zone 2 within a sphere area with 2 m radius from the potential leakage points is claimed around the piping with flanges or threaded joints, meters or regulators and valves other than relief valve in accordance with AS/NZS 60079.10.1 Clause ZA.6.6.2.4 for high pressure gas transmission system.

As a worst case the liquid piping is assumed to carry condensate which is a flammable liquid in accordance with AS/AZS 60079.10.1 clause ZA 5.2.8 that claims a hazardous area of Zone 2 of 1.5m in all directions of potential release points. However the liquid drain lines may contain sufficient quantities of dissolved and entrained. Since this hazardous area classification must account for a number of installations with a range of process conditions, liquid piping is classified as gas piping.

All process drains and vents used infrequently for maintenance or start-ups are normally plugged. Similarly, the sample points are taken on an infrequent or as required basis (maximum once every six months). To simplify hazardous area management, the classification for process gas piping will be assigned to the uncommonly operated process drains, vents and sample points, meaning a Zone 2 area of radius 2 m is declared around those potential leakage points.

The hazard zones adopted for the process piping, flanges, joints, valves and fittings are summarised below:

Zone 2 2 m radius from the edge of the process piping routes, including infrequently used process drains, vents and sample points

2.7.1.2 Instrument Gas Piping

The instrument gas pipework is fabricated from screwed pipe and tube with compression fittings. Similar to process gas piping, the instrument gas piping has potential leakage points at connection points. The leakage is considered abnormal with minor quantities of flammable material. Hence, they are regarded as sources of *Secondary* grade release and the associated hazardous area zone will be classified as Zone 2.

According to AS/NZS 60079.10.1 Clause ZA.6.4.2.3c, for the lighter-than-air flammable gas operating with a pressure between 700 and 2,000 kPag, a hazardous Zone 2 within a sphere area with 1 m radius from the potential leakage points is assigned to the piping with flanged and screwed joints.

The hazard zone adopted for instrument gas piping is summarised below:

Zone 2 1 m radius from the edge of the instrument gas piping routes

2.7.1.3 Fuel Gas Piping

Fuel gas piping is fabricated with screwed connections, except those pipes with a nominal diameter less than DN25 and with flanges for larger diameters. The screwed piping has tapered threads with similar leakage integrity to flanged connections. The leakage is considered abnormal with the presence of minor quantities of flammable material. Hence, they are regarded as sources of *Secondary* grade release and the associated hazardous area zone will be classified as Zone 2.

According to AS/NZS 60079.10.1 Clause ZA.6.4.2.3c, for the lighter-than-air flammable gas operating with a pressure between 100 and 700 kPag, a hazardous Zone 2 within a sphere area with 0.5 m radius from the potential leakage points is declared around the piping with flanged and screwed connections.

The hazard zone adopted for fuel gas piping is summarised below:

Zone 2 0.5 m radius from the edge of the fuel gas piping routes

2.7.1.4 Control Valves

There are several shut down valves, pressure / temperature control valves and level control valves installed in the stations. Similar to process piping, the process connections of control and actuated valves are considered well maintained and leakage is considered abnormal. Therefore connection points are considered the same as process piping as described in Sections 2.7.1.1, 2.7.1.2 and 2.7.1.3.

In addition, the control valves are in regular use and leakage is more likely due to wear on the packing. An additional *Primary* grade of release (Zone 1) with a nominal hazard radius of 0.3 m around the glands is claimed in accordance with IP15 Section 5.4.5.1.

Control valves will release minor amounts of flammable gas with a small continuous bleed from the positioners or exhausts at a low discharge velocity in normal operation. It contributes a *Continuous* grade of release and in accordance with AS/NZS 60079.10.1 clause ZA 6.6.2.5, a Zone 1 area with a 0.5m radius will be claimed. A larger region that represents infrequent higher gas velocities that may exist surrounding the Zone 1 area due to abnormal operation or failure of the valves. A Zone 2 area within 1 m radius in all directions is assigned to the low velocity vents.

The additional hazard zones adopted for the control valves are summarised below:

Zone 1 0.5 m radius around the control valve positioners and exhausts
0.3 m radius around the control and actuated valve glands

Zone 2 1 m radius around the control valve positioners and exhausts

2.7.1.5 Pressure Relief and Safety Relief Valves

Pressure relief valves (PSVs) and safety relief valves (SRVs) are mounted on the multi-cyclone, filters, process gas piping, fuel gas and instrument pipework to provide the protection against operational overpressure for the piping and equipment.

Note that SRVs in Pine Creek Station piped to the vent stack do not contribute to the extent of the hazardous classification except as discussed under Section 2.7.1.1 for process piping.

PSVs and SRVs venting directly to atmosphere are normally treated as a *Secondary* grade of release due to no action on normal operating conditions, and as a result the associated hazard zone will be classified as Zone 2. In accordance with AS/NZS 60079.10.1 Clause ZA.6.6.2.9, a Zone 2 area is assigned within 6 m diameter cylinder with its axis on the line

of discharge from 1 m behind the points of discharge to a distance 8 m in front of the points of discharge.

The seats on the PSVs and SRVs will be metal to metal and tight shut-off, which will contribute to a small leakage at the vent tips during the normal operation. In line with the specification described in IP15 Section 5.4.4.5, a Zone 2 area of nominal 1 m radius should be placed around the end of the discharge point to account for any small leakages. It is recommended to upgrade the *Secondary* grade of release to a *Primary* grade of release accounting for the presence of the flammable material in the normal operating. Hence, an additional Zone 1 area with a nominal hazard radius of 1 m is claimed around the PSV and SRV discharge points to account for the minor leak through the valve seats.

The hazard zones of the PSVs and RSVs are considered to be the same due to lack of the discharge rates, which actually affect the extending zone of hazardous area.

The hazard zones adopted for the PSVs and RSVs are summarised below:

- Zone 1** 1 m radius from the vent tips
- Zone 2** 6 m laterally, 8 m above and 1 m below the discharge points

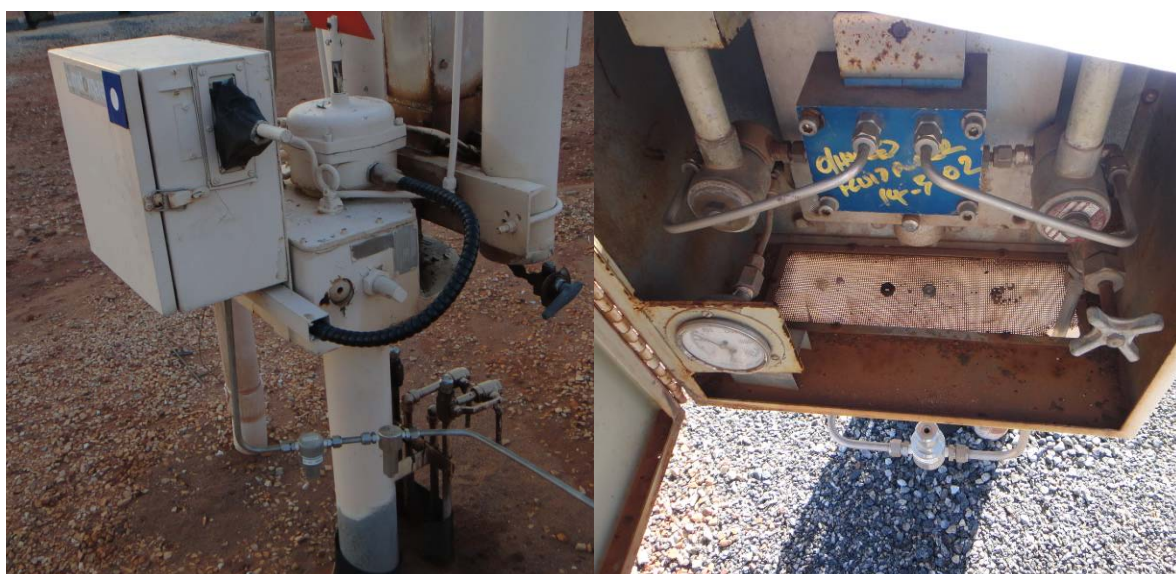
2.7.1.6 Mainline Valves

Some of the actuated mainline valves (MLV) installed at the scraper stations as shown in the following photographs include an enclosure containing the solenoids and a hand pump for the valve. The solenoids vent to a location outside of the enclosure, however the tubing connections to the solenoid are a *Secondary* source of release. The enclosure has minimal ventilation and released gas can accumulate within the enclosure. Therefore a Zone 1 hazardous area is claimed within the enclosure.

Body bleeds valves maintenance ports and instrument gas connections from the buried valve are brought above grade. These provide potential leak sources and are treated the same as process piping connections as per section 2.7.1.1.

The hazard zone adopted for the actuated valve enclosures is summarised below:

- Zone 1** Within the solenoid valve enclosure
- Zone 2** 2m radius from point of discharge



2.7.1.7 Local Vent Point

There are several local vent points installed in the facilities to allow the purging of gas from the stations following isolation. Each manual vent generally consists of a ball valve to control blow down rate. The ball valve provides high integrity isolation and wear is not considered on the valves. Hence, no leak is taken into account during the normal operation.

The hazardous area classification for those points is considered to be the same as PSVs and RSVs due to the similar operation which happens only during the period of system depressurisation. Therefore, they are treated as a *Secondary* grade of release and a Zone 2 area within 6 m diameter cylinder with its axis on the line of discharge from 1 m behind the points of discharge to a distance 8 m in front of the points of discharge are declared in accordance with AS/NZS 60079.10.1 Clause ZA.6.6.2.9.

Note: Majority of the vents are fitted with a cap and have a hole drilled in the vent pipe.

The hazard zone adopted for the local vent points is summarised below:

Zone 2 6 m laterally, 8 m above and 1 m below the discharge points

2.7.1.8 Pine Creek Vent Stack

There is a vent stack installed in the Pine Creek Station. Gas released from the PSVs, instrument manifold vents and vented instrument gas from the pneumatic controllers is sent to the vent stack. During normal operation, there is minimal flow from the vent stack from the pneumatic controllers. The vent stack is fitted with a flame arrester that offers protection against fire and explosion from outside sources of ignition. The flame arrester is fitted with a cover to prevent rain ingress but also acts to direct gas downwards. and will increase the diameter of the hazardous area.

The hazardous area is increased to a Zone 2 area within 12 m diameter cylinder and 6 m below the discharge point is claimed, compared with 8 m distance stated for vertical up discharge.

Furthermore, minor leakage of flammable mixture may occur through the PSV seats under normal operation as analysed in Section 2.7.1.5. As a result, it contributes to a *Primary* grade of release and an additional Zone 1 hazardous area with a nominal radius of 1 m is claimed around the vent stack discharge point to account for any small leakages from safety relief valve seats.

The continuous bleed from the pneumatic controllers also vents through the vent stack. As per Section 2.7.1.4, a 0.5 m Zone 1 hazardous area is claimed. This is within the hazardous area claimed for leakage through PSV seats.

The pipework to the vent stack is flanged and will generally be at close to atmospheric pressure. However for continuity the claimed hazardous area will be claimed to be as for process pipework, refer section 2.7.1.2.

The hazard zones adopted for the vent stack are summarised below:

Zone 1 1 m radius from the vent tip

Zone 2 12 m laterally, 6 m below and 8 m above the vent tip

2.7.1.9 Pipeline Blowdown

There are pipeline blowdown points at the scraper stations and meter stations. The vents are approximately 2.4 m tall, discharge vertically upwards and are fitted with quick opening closures. Pipeline blowdowns have the potential to release large volumes of gas to atmosphere and to obtain a representative hazardous area zone it would be required to

undertake plume analysis based on the blowdown conditions. An estimate of the extent of the plume from previous experience for pipeline blowdown vents is a cylinder with a radius of 15 m and a length of 30 m extending in the direction of the discharge and 1 m below the discharge point to account for the localised turbulence at the vent tip. Pipeline blowdowns are done infrequently and therefore a *Secondary* release that results in a Zone 2 hazardous area. The discharge is vertically upwards and therefore no ground effect would occur.

During normal operation a quick opening closure in the closed position is considered to provide similar containment as a pipe flange or fitting. Therefore the associated release would be *Secondary* providing a Zone 2 hazardous area of 2 m as per AS/NZS 60079.10.1 Clause ZA.6.4.2.4.

Zone 2 A cylinder of radius 15 m extending 30 m vertically upwards and 1 m downwards from the point of discharge

HOLD The exact shape of the hazardous area zone should be determined using plume dispersion modelling based on the blowdown operation and conditions.

2.7.1.10 Low Velocity Vents

There are numerous pressure relief valves installed on instrument gas systems, for example on the station limit valves. The relief from these pressure relief valves are similar to low velocity vents in accordance with AS/NZS 60079.10.1 ZA.6.6.2.8 that has an associated Zone 1 hazardous area of 0.5 m in all directions surrounded by a Zone 2 hazardous area of 1.0 m from the point of discharge. The pressure relief valves will not typically be relieving gas and the release will be *Secondary*, therefore the Zone 1 area is not appropriate. Therefore a Zone 2 hazardous area of 1 m radius from the point of discharge is claimed.

The hazard zone adopted for the instrument gas relief and vent points is summarised below:

Zone 2 Radius of 1 m extending in all directions from the point of discharge

2.7.2 SCRAPER VESSELS

The scraper vessels shall be operated such that it is normally isolated from the pipeline. There are no regular pigging operations. It is expected that the scraper vessels are opened at approximately yearly intervals and the small quantities of flammable gas may occur at the closures. Accordingly, they are treated as sources of *Secondary* grade release and a hazardous Zone 2 within a radius of 3 m centred at the closure is claimed as identified in AS/NZS 60079.10.1 ZA.6.6.2.2b for the equipment located at an adequately ventilated area.

The scraper vessels are enclosed vessels containing nozzle connections with piping, valves and fittings, which are also potential release sources. These are classified as piping as per section 2.7.1.1.

The hazard zone adopted for the pig receivers and launchers is summarised below:

Zone 2 3 m radius in all directions from quick opening closure
As per section 2.7.1.1 for piping for remainder of the vessel

2.7.3 MULTICYCLONE AND FILTER SEPARATORS

Similar to receiving traps, the multicyclone and filter separators have quick opening closures that are operated at approximately yearly intervals under normal operation. The hazard zone assigned to the receiving traps in accordance with AS/NZS 60079.10.1 ZA.6.6.2.2b is also applicable to the filter coalescers, resulting in a hazardous Zone 2 area within 3 m radius around the discharge points is claimed.

Since the multicyclone and filter coalescers are enclosed vessels which handle process gas and liquids removed from the gas, the nozzle connections with piping, valves and fittings are also potential release points. To simplify hazardous area management, the classification for process gas piping will be applied to the vessels meaning a Zone 2 area of radius 2 m will be declared from the shell of the vessels.

The hazard zone adopted for the multicyclone and filter coalescers is summarised below:

Zone 2 3 m radius around the quick opening closures and 2 m radius from the edge of the vessels

2.7.4 SLOP TANKS

The slop tank installed at some stations are above ground storage tank used to collect condensate, compressor lube oil and water from the filter separators. The liquids in the tank are treated as a flammable fluid. The capacity of the tanks are approximately 1 kL. The tanks are provided with a vent that discharges to atmosphere. During the short period of the drainage from the filter coalescers to slop tank, the liquids may form a flammable mist and additionally the gas may break through into the drain tank. The freely vented tank allows vapour/air mixtures to be released during the normal operation.

Therefore, the slop tank will contain flammable vapours and a range of hazard zones is required. As such, it is likely that a small amount of flammable gas mixture would continuously exist in the tank and within close proximity of the tank vent, surrounded by a larger region that may sometimes exist due to occasional higher gas quantities and an even larger region that represents very infrequent high gas quantities.

The slop tank installed at the Pine Creek Station has a pressure vacuum vent set at 2 kPa pressure / vacuum. The vapour or released gas is directed to atmosphere through the vent that installed in conjunction with an inline flame arrester and a cap. The flame arrester is required to provide protection against internal fire and explosion from outside sources of ignition. The vented gas will be discharged vertical downwards to the surrounding equipment or pipework due to the installation of the cap. However, the additional extent zones are not claimed considering the relatively low operating pressure in the tank.

In accordance with API RP 505 Section 8.2.1, a Zone 0 area within 0.5 m radius, a Zone 1 area within 1.5 m radius and a Zone 2 area within 3 m radius of the vent point are declared. It is also stated in API RP 505 Section 8.2.1, a Zone 0 area should be claimed inside the tank above the liquid level due to the possibility of the continuous presence of the flammable mixture and a Zone 2 area with radius of 3 m should be placed around the shell of the equipment.

The hazard zones adopted for the slop tanks in the stations are summarised below:

Zone 0 Inside the tanks above the liquid level and 0.5 m radius from the tank discharge points

Zone 1 1.5 m radius from the tank discharge points

Zone 2 3 m radius around the shell of the tanks and from the tank discharge points

2.7.5 WATER BATH HEATERS

The indirect fired water bath heaters are fitted in some stations to heat the high pressure gas up to a temperature of 60 °C prior to pressure reduction, which prevents hydrate formation that may occur due to the Joule-Thomson effect when the temperature drops. The water bath heater consists of an insulated shell, removable process coils, removable fire tubes, stack burners, fuel gas conditioning train and control system.

During normal operation, a flame is projected into a submerged "fire-tube" located at the bottom of a horizontal cylindrical shell. Energy is transferred through the tube wall to the surrounding bath fluid water. By means of natural convection, the water then transfers the required amount of energy into a series of process coils located at the top of the heater shell.

The water bath burners are continuously flaming and provided with burner elements to ensure that the flame is maintained. On loss of flame the fuel gas supply is shut down. Therefore no hazardous area zones are claimed from the stacks.

The process tube within the water bath is fully welded with no potential points for release and would not normally provide a hazardous area. If there was a history of failure of the process coils leading to corrosion or erosion of the tubes, then a hazardous area should be claimed on the vent of the water bath heater. APA has not indicated that there have been failures of the process coils. Further, the maximum operating temperature of the water bath heaters is 95°C, the pH and the nitrate content of the water in the baths is checked frequently and APA has confirmed that the water bath heaters are treated with oxygen scavenger. Therefore no hazardous area is claimed from the water bath vent.

The potential release points on the vessels are process connections to the heaters. The classification for process piping will be applied to the process connections resulting in a *Secondary* grade of release and a related Zone 2 area with 2 m radius from the connection points in accordance with AS/NZS 60079.10.1 Clause ZA.6.4.2.4.

The hazard zone adopted for the water bath heaters is summarised below:

Zone 2 2 m radius from the high pressure gas connections of the vessel.

2.7.6 CATALYTIC HEATER

A catalytic heater is installed at the Elliott meter station. The heater consists of a section of pipe contained in a compartment. The inside of the compartment is surrounded by heating elements that heat the gas by radiant heat. The heat is generated by the combustion of gas in catalytic elements. The manufacturer's information indicates that the catalytic elements ensure that the gas is combusted at a lower temperature. The heating unit is approved for installation in hazardous areas and has Factory Mutual certification.

The pipework has no additional source of release and will be classified the same as the process pipework as described in section 2.7.1.1 and a 2 m Zone 2 hazardous area is claimed from the outside of the heater.

Additionally, there is a possibility of fuel gas not being combusted inside the heater. The manufacturer's literature indicates that there is a protection to prevent uncombusted gas being released. However the configuration of the heater is not well defined and to be conservative a primary grade of release is claimed. There is minimal ventilation in the compartment and the claimed zone is increased from Zone 1 to Zone 0 within the compartment.

The heater compartment is not considered to be gas tight and an additional hazardous area zone is claimed that will surround the heater compartment. The release will be a primary grade of release. The heater has good ventilation and a Zone 1 hazardous area is claimed. The released gas will be fuel gas and will be close to atmospheric pressure. In accordance with section 2.7.1.3 the extent of the hazardous area will be 0.5 m from the outside of the box.

The hazard zone adopted for the catalytic heater is summarised below:

- Zone 0** Inside the heater compartment
- Zone 1** 0.5 m from the edges of the heater box
- Zone 2** 2 m radius from the high pressure gas connections of the vessel

2.7.7 KNOCKOUT POTS

The knockout pots are enclosed vessels which do not contribute to the hazardous area classification. However, the nozzle connections with piping, valves and fittings on the vessels are potential release points where small amounts of flammable mixture may present. To simplify hazardous area management, the classification for process gas piping will be applied to the vessels meaning a Zone 2 area of radius 2 m will be declared from the shell of the vessels.

The hazard zone adopted for the knockout pots is summarised below:

- Zone 2** 2 m radius from the edge of the vessels

2.7.8 GAS CHROMATOGRAPH SYSTEM

Gas chromatograph (GC) system is a specific analyser to determine natural gas stream composition and anticipated concentration of the selected components.

The chromatograph system comprises of several components: the analyser, sample tubing, process vents, pressure control valve, pressure safety valve, carrier gas cylinders and tubing, calibration gas cylinder and tubing. The chromatograph system is located under a shelter with open sides, therefore it is considered as being adequately ventilated.

The process tubing and analyser contain gas at approximately 140 kPag. The tubing will be well maintained and minor release of the flammable gas may occur at the connections due to leakage, and as a result the grade of release is considered to be *Secondary*. Therefore, a Zone 2 hazardous area with 0.5 m radius is assigned around the whole chromatography system to cover the process tubing potential leakage points according to AS/NZS 60079.10.1 Clause ZA.6.4.2.3c, for the lighter-than-air flammable gas operating at a pressure between 100 and 700 kPag.

The carrier gas is helium that is a non-hazardous material and therefore the carrier gas cylinders and tubing do not contribute to the hazardous zone.

The calibration gas comprises mainly methane and stores in a gas cylinder with an approximate volume of less than 10 L. AS/NZS 60079.10.1 Clause ZA.6.4.2.6d states that cylinder located in ventilated area, whether in storage or installed for use, is not associated with a hazardous zone when the gas capacity is less than 30 m³. Therefore, no hazardous zone is claimed around the calibration gas cylinder. The calibration gas tubing is at the same operating pressure as the process tubing and will have the same Zone 2 hazardous with 0.5 m radius around the calibration gas tubing connections.

The chromatograph system has several vent points that release the sample line contents at low velocity during the normal operation. The amount of the released gas will be small and the discharge rate will be slow and readily dispersed. Consequently, they are regarded as sources of *Primary* grade release and a hazard Zone 1 within a sphere area with 0.5 m

radius is declared from the vent tips in accordance with AS/NZS 60079.10.1 Clause ZA.6.6.2.8 for the low velocity vents in adequately ventilated area.

In addition, a larger region that represents infrequent higher gas quantities may exist surrounded the Zone 1 area due to the failure of pressure regulator or PSV. It results a *Secondary* grade of release and an additional Zone 2 area with 1 m radius is considered around the vents in accordance with AS/NZS 60079.10.1 Clause ZA.6.6.2.8.

The pressure relief valve will be activated in emergency. To simplify the hazardous area arrangement, it is treated the same as a vent as described above.

The hazard zones adopted for the chromatograph system are summarised below:

- Zone 1** 0.5 m radius from the vent tips
- Zone 2** 0.5 m radius around the gas chromatograph system, excluding the cylinders
 1.0 m radius around the vent tips

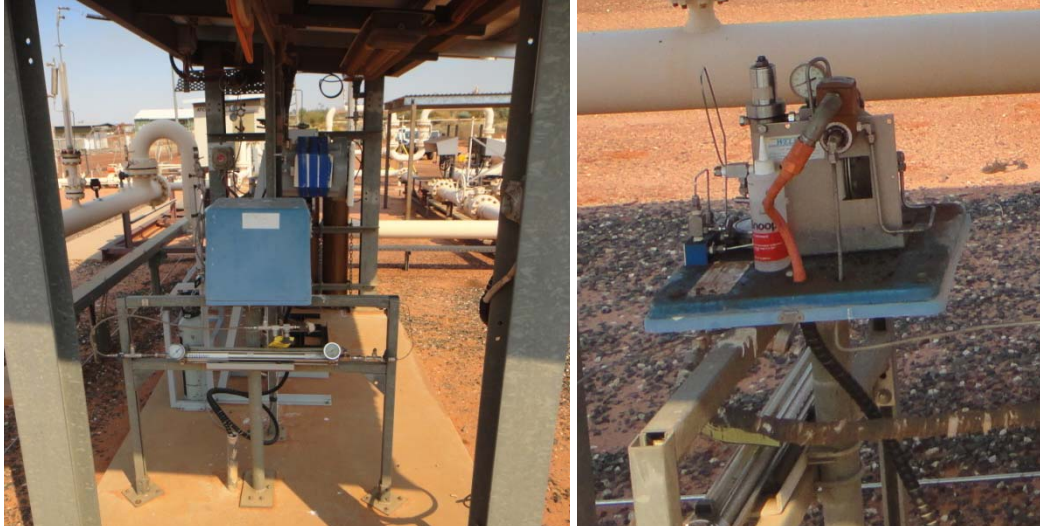
2.7.9 WATER DEW POINT ANALYSER / GAS SAMPLER

The water dew point analyser uses a chilled mirror to determine the dew point of the gas. The analysers receive gas from the sampler as shown in the photographs below. The gas sampler consists of an insertion regulator installed in the pipework, a heated capillary tube a sample cylinder, solenoid valve, further regulators and pressure relief valves. A solenoid valve is installed inside a box with a removable cover. The box prevents ventilation and therefore the declared hazardous area zone is increased to Zone 1 for the interior of the box.

The water dew point analyser comprises of several components: the analyser, sample tubing, process vents, pressure control valve, pressure safety valve, gas cylinders and tubing, calibration gas cylinder and tubing. The analyser system is located under a shelter with open sides, therefore it is considered as being adequately ventilated.

The process tubing and analyser contain gas at approximately 140 kPag. The tubing will be well maintained and minor release of the flammable gas may occur at the connections due to leakage, and as a result the grade of release is considered to be *Secondary*. Therefore, a Zone 2 hazardous area with 0.5 m radius is assigned around the whole analyser system to cover the process tubing potential leakage points according to AS/NZS 60079.10.1 Clause ZA.6.4.2.3c, for the lighter-than-air flammable gas operating at a pressure between 100 and 700 kPag.

The water dew point analyser and gas sampler have local vents that will frequently vent gas at low velocity to atmosphere during the normal operation. The amount of the released gas will be small and the discharge rate will be slow due to the characterisation of the systems. Consequently, they are regarded as sources of *Primary* grade release and a hazard Zone 1 within a sphere area with 0.5 m radius is declared from the vent tips in accordance with AS/NZS 60079.10.1 Clause ZA.6.6.2.8 for the low velocity vents in adequately ventilated area.



The hazard zone adopted for the water dew point analyser / gas sampler is summarised below:

- Zone 1** 0.5 m radius from the vent tips
 Inside the sampler box
- Zone 2** 0.5 m radius around the water dew point analyser system
 1.0 m radius around the vent tips

2.7.10 ODORANT INJECTION SYSTEM

2.7.10.1 Odorant Pipework

A majority of the odorant pipework is tubing fitted with compression fittings, these are considered to be well maintained and infrequently operated. This provides a *Secondary* source of release and a Zone 2 hazardous area. In accordance with AS/NZS 60079.10.1 Clause ZA.5.2.8 the associated hazardous area is 1.5 m in all directions down to ground level.

- Zone 2** 1.5 m in all directions extending down to ground level

2.7.10.2 Odorant Storage Tank

The odorant storage tank is a pressure vessel supplied with a natural gas blanket and a pressure relief valve.

AS/NZS 60079.10.1 Clause ZA.5.2.1.2c describes the hazardous area associated with the above ground vent on a storage tank as Zone 1 within 1.5 m radius in all directions from point of discharge and Zone 2 within the cylindrical volume below the Zone 1 area. This is applicable for a vent on a storage vessel. There will be a constant release from the vent however the volume of release is small and is considered to be a *Primary* and a Zone 1 area is claimed.

The connections on the pressure vessel will have the same Zone 2 hazardous area as the odorant pipework.

The tank pressure relief valve will provide a *Secondary* release. This will result in a Zone 2 hazardous area. The extent of the hazardous area will be as the Zone 1 area for the vent, but without the additional Zone 2 area.

- Zone 1** 1.5 m in all directions from vent tip
- Zone 2** Cylindrical volume below the Zone 1 area
1.5 m in all directions extending down to ground level for tank connections

2.7.10.3 Odorant Injection Pumps

The odorant injection pumps are pneumatically powered from instrument gas that is derived from the transmission gas. During operation of pumps there will be a continuous vent of gas. There will be a *Continuous* release from the pump discharge through a bug screen located on the pump, refer photograph below. The minimum diameter of the instrument gas is small. It is reasonable to assume that the solenoid valve has a reduced bore, and a typical size is 1/8" (3.2 mm). Based on Table C9(a) from IP15 for a G(i) gas, a pressure of 5 bar(a) (400 kPag) and a 5 mm hole the hazard radius is <1 m. Therefore a hazardous radius of 0.5 m is claimed around the pump.

The pump is a high integrity positive displacement pump capable of developing high discharge pressures to the odorant, therefore it is assumed that any hazardous area associated with leakage from the pump seals would be small and within the hazardous zone associated with the gas vent.



- Zone 1** 0.5 m radius from the pump

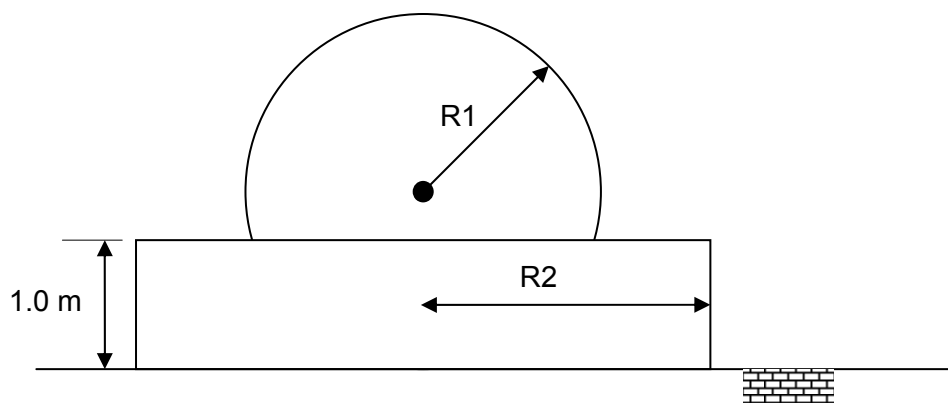
2.7.11 GROUND EFFECT

IP 15 Section 5.5 states that the determination of the full three dimensional envelope of the hazardous area zone shall consider the location of the release. The shape factor depends on height and orientation of the release. The key factors are:

1. For sources of release that are higher from grade than the hazardous radius, there is no impact due to ground effect.
2. For sources of release that are higher than 1 m from grade but less than the hazardous radius, there is a ground effect, up to 1 m above grade.
3. For sources of release that are 1 m or less from grade, there is a ground effect up to 1 m above grade.

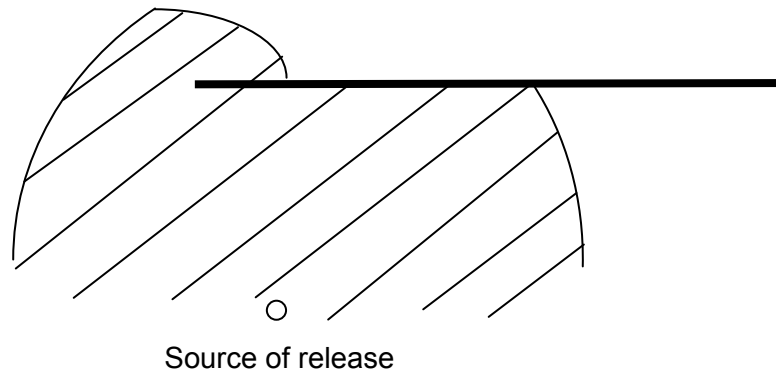
The main process pipework has a hazardous area of radius 2 m, and is located less than 2 m above grade. The direction of release from flanged joints and screwed fittings could be in any direction, therefore ground effects are to be considered. Other hazardous area zones will be sufficiently above grade so that there is no ground effect, or the direction of release will be upwards and therefore ground effect is negligible.

The ground effect increases the hazardous radius in accordance with IP 15 Table C9(b). A majority of the pipework in the facilities is to be located less than 1 m above grade. Interpolation of IP 15 Table C9(b) shows that the hazardous area for ground effect is 0.5 m larger than the hazardous area radius defined above, from the figure below, $R_2 = R_1 + 0.5$. Therefore the hazardous area at grade for gas pipework at transmission pressure will be 2.5 m to a height of 1 m.



2.7.12 VAPOUR BARRIERS

At Palm Valley Alice Springs and Mereenie the hazardous area zone impacts on a wall and the control hut, respectively. At these locations the hazardous area zone will extend around the barrier as shown in the diagram below. This is in accordance with AS/NZS 60079.10.1 Clause ZA.2 for measurements of distances.



APPENDIX A HAZARDOUS AREA CLASSIFICATION DATA SHEET

- Part I : Flammable material list and characteristics
- Part II : List of sources of release

Part I – Sheet 1 of 1

Flammable material list and characteristics

Amadeus Basin to Darwin Pipeline

Surface facilities



Revision:	0				
Author:	TCB				
Checked:	RDK				
QA:	EZG				
Date:	24/11/2011				

Material	Phase	ADG Class	IP 15 Fluid Category	Boiling Point °C	ASTM D86 5%(vol) Point of Stabilised Liquid at Atmospheric Pressure	Relative Density Of Fluid Vapour (Air SG=1) Liquid (Water SG=1)	Flash Point of Stabilised Liquid at Atmospheric Pressure °C	Vapour LEL (Vol %) In Air	Vapour UEL (Vol %) In Air	Ignition Temperature °C	Temperature Class	Equipment Group	Source Of Data
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Process gas and calibration gas (mixture)	Vapour	2.1	G(i)	-162	-	0.62	Gas	4.4 (Methane)	17 (Methane)	537 (Methane)	T1	IIA	AS/NZS 60079.20
Odorant (tetrahydrothiophene and tertiary butyl mercaptan)	Liquid	3	C	82	-	0.939 (liquid) 3.06 (vapour)	-8	1.1*	12.1*	224	T3*	IIA	AS/NZS 60079.20 MSDS
Condensate	Liquid	3	C	69 [†]	-	2.97 [†]	-21 [†]	1.0 [†]	8.4 [†]	233 [†]	T3 [†]	IIA	AS/NZS 60079.20

* Values obtained for Tetrahydrothiophene

[†] Based on Hexane

Part II – Sheet 1 of 4

List of sources of release

Amadeus Basin to Darwin Pipeline

Surface facilities



Revision:	0				
Author:	TCB				
Checked:	RDK				
QA:	EZG				
Date:	24/11/2011				

Process Equipment Item			Flammable Material	Operating Conditions Pressure and Temperature	Description of Flammable Material Containment	Ventilation	Source Of Release		Distance From Source To			Equipment Group and Temperature Class	Section
No.	Description	Location					Description	Grade*	Boundary of Zone 0	Boundary of Zone 1	Boundary of Zone 2		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Process piping	Amadeus Basin to Darwin Pipeline surface facilities	Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Closed system with flanges, piping joints and valves	Natural (open air)	Flanges, joints, valve seals, drains and vents	S	N/A	N/A	2 m radius from the edge of piping routes	IIA, T1	2.7.1.1
2	Instrument gas piping		Vap. Cat "G(i)"	≤ 770 kPag ≤ 60 °C	Closed system with flanges, piping joints and valves	Natural (open air)	Flanges, joints, valve seals, drains and vents	S	N/A	N/A	1 m radius from the edge of piping routes	IIA, T1	2.7.1.2
3	Fuel gas piping		Vap. Cat "G(i)"	≤ 700 kPag ≤ 60 °C	Closed system with flanges, piping joints and valves	Natural (open air)	Flanges, joints, valve seals, drains and vents	S	N/A	N/A	0.5 m radius from the edge of piping routes	IIA, T1	2.7.1.3
4	Control valves		Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Valves with packed gland / positioner / exhaust	Natural (open air)	Valve glands, positioners and connections	C & P & S	N/A	0.5 m radius around control valve positioners and exhaust	1 m radius around control valve positioners and exhausts;	IIA, T1	2.7.1.4
5	Pressure relief and safety relief valves		Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Valves and piping discharging vertically upwards	Natural (open air)	Pipe vent to atmosphere	C & P	N/A	1 m radius from vent tips	6 m laterally, 8 m above and 1 m below discharge points	IIA, T1	2.7.1.5
6	Mainline valves		Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Closed system with flanges, piping joints and valves	Natural (open air)	Connections and valve seals	S	N/A	Within solenoid valve enclosure	As Piping	IIA, T1	2.7.1.6
7	Local Vent Points		Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Valves and piping discharging vertically upwards	Natural (open air)	Pipe vent to atmosphere	S	N/A	N/A	6 m laterally, 8 m above and 1 m below discharge points	IIA, T1	2.7.1.7

* C – Continuous; S – Secondary; P – Primary

Part II – Sheet 2 of 4

List of sources of release

Amadeus Basin to Darwin Pipeline

Surface facilities



Revision:	0				
Author:	TCB				
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Date:	24/11/2011				

Process Equipment Item			Flammable Material	Operating Conditions Pressure and Temperature	Description of Flammable Material Containment	Ventilation	Source Of Release		Distance From Source To			Equipment Group and Temperature Class	Section
No.	Description	Location					Description	Grade*	Boundary of Zone 0	Boundary of Zone 1	Boundary of Zone 2		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
8	Pine Creek vent stack	Pine Creek	Vap. Cat "G(i)"	Atmospheric pressure Ambient temperature	Valves and piping discharging vertically upwards	Natural (open air)	Pipe vent to atmosphere	P & S	N/A	1 m radius from the vent tip	12 m laterally, 6 m below and 8 m above vent tip	IIA, T1	2.7.1.8
9	Pipeline blowdown	Amadeus Basin to Darwin Pipeline surface facilities	Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Valves and piping discharging vertically upwards	Natural (open air)	Pipe vent to atmosphere	S	N/A	N/A	A cylinder of radius 15 m extending 30 m vertically upwards and 1 m downwards from discharge point HOLD – To be confirmed	IIA, T1	2.7.1.9
10	Low velocity vents		Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Valves and piping discharging vertically upwards	Natural (open air)	Pipe vent to atmosphere	S	N/A	N/A	Radius of 1 m extending in all directions from the point of discharge	IIA, T1	2.7.1.10
11	Scraper vessels		Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Enclosed system with closures	Natural (open air)	Flanges, joints, valve seals, drains and vents	S	N/A	N/A	3 radius in all directions from quick opening closure As per section 2.7.1.1 for piping for remainder of the vessel	IIA, T1	2.7.2
12	Multicyclone and filter separators		Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Enclosed vessels with quick opening closures	Natural (open air)	Flanges, joints, valve seals, drains and vents	S	N/A	N/A	3 m radius around the closures and 2 m radius from the edge of the vessels	IIA, T1	2.7.3
			Liq. Cat "C"	≤ 9,650 kPag ≤ 60 °C	Liquid drain pipework	Natural (open air)	Piping connections	S	N/A	N/A	2 m in all directions down to ground level	IIA, T3	2.7.1.1

* C – Continuous; S – Secondary; P – Primary

Part II – Sheet 3 of 4

List of sources of release

Amadeus Basin to Darwin Pipeline

Surface facilities



Revision:	0				
Author:	TCB				
Checked:	RDK				
QA:	EZG				
Date:	24/11/2011				

Process Equipment Item			Flammable Material	Operating Conditions Pressure and Temperature	Description of Flammable Material Containment	Ventilation	Source Of Release		Distance From Source To			Equipment Group and Temperature Class	Section
No.	Description	Location					Description	Grade*	Boundary of Zone 0	Boundary of Zone 1	Boundary of Zone 2		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
13	Slop tanks	Amadeus Basin to Darwin Pipeline surface facilities	Vap. Cat "G(i)"	Atmospheric pressure Ambient temperature	Open vessels	Natural (open air)	Piping connections and vents	C & P & S	Inside the tank above liquid level and 0.5 m radius from tank discharge points	1.5 m radius from tank discharge points	3 m radius from around shell of tanks and from tank discharge points	IIA, T1	2.7.4
14	Water bath heaters		Vap. Cat "G(i)"	≤ 9,900 kPag ≤ 60 °C	Enclosed vessels	Natural (open air)	Piping connections	S	N/A	N/A	2 m radius from high pressure gas connections of vessel	IIA, T1	2.7.5
15	Catalytic heater		Vap. Cat "G(i)"	≤ 9,900 kPag ≤ 60 °C	Enclosed vessels	Natural (open air)	Piping connections	S	Inside the heater compartment	0.5 m from the edge of the heater compartment	2 m radius from high pressure gas connections of vessel	IIA, T1	2.7.6
16	Knockout pots		Vap. Cat "G(i)"	≤ 9,900 kPag ≤ 38 °C	Enclosed vessels	Natural (open air)	Piping connections	S	N/A	N/A	2 m radius from edge of vessels	IIA, T1	2.7.7
17	Gas chromatograph systems		Vap. Cat "G(i)"	≤ 140 kPag ≤ 60 °C	Closed tubing systems with joints and vents	Shelter with open sides (open air)	Tubing joints, drains and vents	P & S	N/A	0.5 m radius from vent tips	0.5 m radius around system, excluding cylinders 1.0 m radius around vent tips	IIA, T1	2.7.8
18	Water dew point analysers / gas samplers		Vap. Cat "G(i)"	≤ 140 kPag ≤ 60 °C	Closed tubing systems with joints and vents	Shelter with open sides (open air)	Tubing joints, drains and vents	P & S	N/A	0.5 m radius from vent tips Inside sampler box	0.5 m radius around the system, 1.0 m radius around vent tips	IIA, T1	2.7.9

* C – Continuous; S – Secondary; P – Primary

Part II – Sheet 4 of 4

List of sources of release

Amadeus Basin to Darwin Pipeline

Surface facilities



Revision:	0					
Author:	TCB					
Checked:	RDK					
QA:	EZG					
Date:	24/11/2011					

Process Equipment Item			Flammable Material	Operating Conditions Pressure and Temperature	Description of Flammable Material Containment	Ventilation	Source Of Release		Distance From Source To			Equipment Group and Temperature Class	Section
No	Description	Location					Description	Grade*	Boundary of Zone 0	Boundary of Zone 1	Boundary of Zone 2		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
19	Odorant injection system pipework	Tylers Pass odorant injection station	Vap. Cat "C"	≤ 9,650 kPag ≤ 60 °C	Closed system with flanges, piping joints and valves	Natural (open air)	Flanges, joints, valve seals, drains and vents	S	N/A	N/A	1.5 m in all directions down to ground level	IIA, T3	2.7.10.1
20	Odorant injection system storage tanks		Vap. Cat "C"	15 kPag ≤ 60 °C	Enclosed vessel	Shelter with open sides (open air)	Connections	S	N/A	N/A	1.5 m in all directions down to ground level	IIA, T3	2.7.10.2
					Blanket gas vent		Pipe vent to atmosphere	P		Radius of 1.5 m in all directions from vent tip	Within cylindrical volume below Zone 1		
					Pressure relief valve and piping discharging vertically upwards		Pipe vent to atmosphere	S		N/A	Radius of 1.5 m in all directions from vent tip		
21	Odorant injection system pumps		Vap. Cat "G(i)"	≤ 400 kPag ≤ 60 °C	Pneumatic pump instrument gas exhaust	Shelter with open sides (open air)	Piping connections and vents	C	N/A	N/A	Radius of 0.5 m	IIA, T1	2.7.10.3
22	Ground effect	Amadeus Basin to Darwin Pipeline surface facilities	Vap. Cat "G(i)"	≤ 9,650 kPag ≤ 60 °C	Closed system with flanges, piping joints and valves	Natural (open air)	Flanges, joints, valve seals, drains and vents	S	N/A	N/A	2.5 m laterally and extending to 1 m above grade for all process piping less than 2 m above grade	N/A	2.7.12

* C – Continuous; S – Secondary; P – Primary

APPENDIX B HAZARDOUS AREA MAPPING DRAWINGS

For hazardous area mapping drawings, refer to Section 4 of the Hazardous Area Dossiers for each site.

3 Observation for Improvement (OFI)

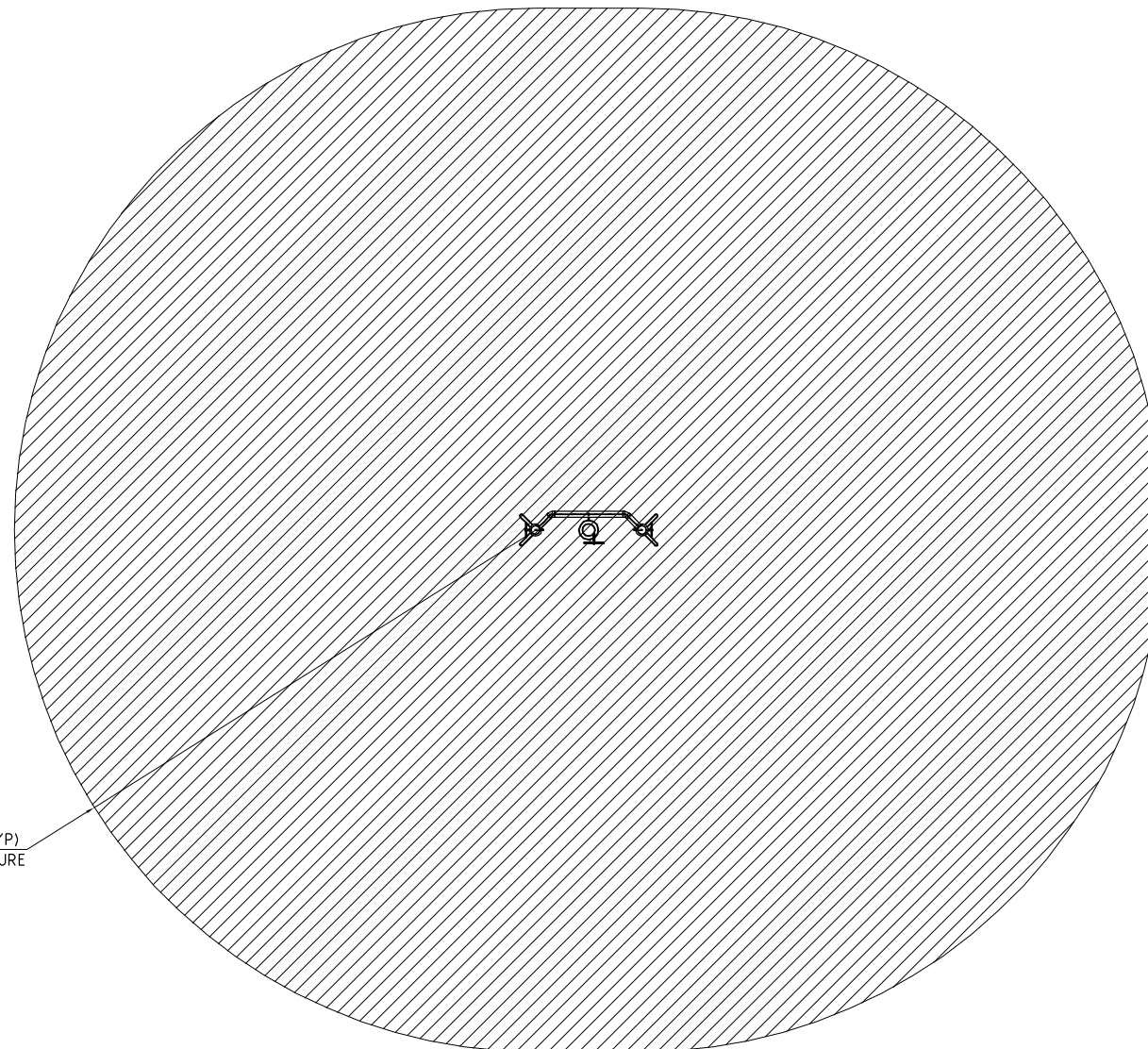
This site does not contain any electrical equipment in the hazardous area.

OFI No.	Description	Proposed Remedy
AD 0241-OFI-1 Vent	The exact dimensions and shape of the hazardous area of the plume from the pipeline vent requires review.	Undertake plume dispersion modelling.

4 Hazardous Area Mapping Drawings

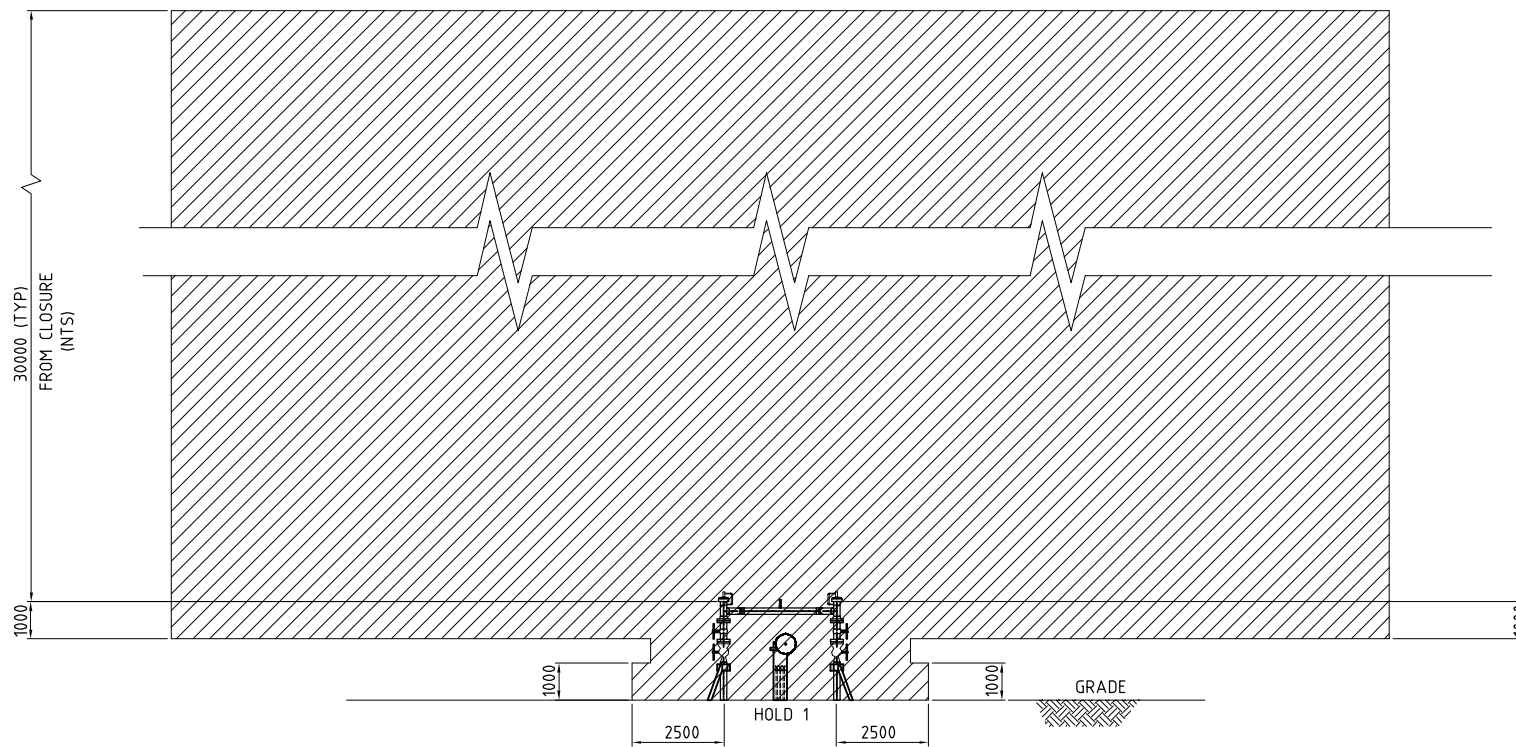
This section contains the hazardous area mapping drawings.

Drawing Number	Description	Revision
AD 0241-5001	Mainline Valve Assembly 350 NS Hazardous Area – Aileron	0






R15000 (TYP)
FROM CLOSURE

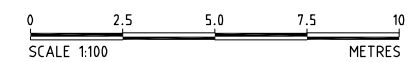
PLAN VIEW (01)
SCALE 1:100



ELEVATION (A)
SCALE 1:100

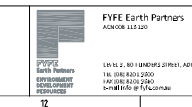

CLASSIFICATION LEGEND

-  ZONE 0
 -  ZONE 1
 -  ZONE 2
- GAS IIA T1



- NOTES
- ALL BELOW GRADE PIPING AND EQUIPMENT NOT SHOWN FOR CLARITY OF DRAWINGS
 - ACTUAL SHAPE AND EXTENT OF HAZARDOUS AREA TO BE DETERMINED BY PLUME ANALYSIS

REV	REVISION CHECKED BY	DATE	CHKD	APPD	REFERENCE DRAWINGS	ORIGNAL
1						

 <p>FVFE Earth Partners AECOM 112 200</p>	 <p>PROJECT: AMADEUS BASIN TO DARWIN PIPELINE HAZARDOUS AREA - AILERON</p>	SHEET NO. 11 SCALE: AS SHOWN DATE: 08/20/2014	PROJECT NO. AIL004-03001
		DRAWING NO. AIL004-03001	REV. 0

5 Hazardous Area Equipment Register and Certificates of Conformity

This site does not contain any electrical equipment in the hazardous area. As a result, there are no Certificates of Conformity.



Aileron Mainline Valve Hazardous Area Equipment Register

APA Group ○

Doc No.	18756-4-70-006
Rev.	
Date	

Tag	P&ID No.	Location	Instrument Type	Manufacturer	Model	Serial No.	Hazard Area Drawing No.	Haz Area Classification			Ex Protection	Certification
								Zone	Gas Group	Temp.		

6 Datasheets and Electrical Drawings

Documentation in relation to this section is to be included and maintained by APA Group.

7 Calculations

Documentation in relation to this section is to be included and maintained by APA Group.

Calculations need to be confirmed for equipment installed in hazardous areas. These include heat dissipation calculation for Ex e and intrinsically safe barrier assessment for Ex i, which are relevant for the ADP sites.

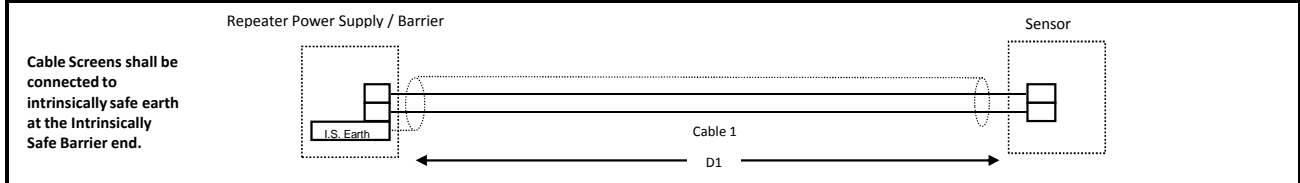
This section contains sample calculation sheet for intrinsically safe barrier assessment and extracts from AS 2381.6-1993 and AS 2381.7-1989.

Intrinsically Safe Barrier Assessment Sheet



Document No:		Prepared By:	
Site:		Checked:	
Loop Description:		QA:	
Loop Drawing Number:		Approved:	
		Date:	

Hazardous Area: H. A. Report: <input style="width: 100%;" type="text"/> H. A. Drawing No.: <input style="width: 100%;" type="text"/>	Area Class: <input style="width: 100%;" type="text"/> Gas Group: <input style="width: 100%;" type="text"/> Temperature Class: <input style="width: 100%;" type="text"/>
---------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------



I.S. Device details (Hazardous Area) [Note 2]	
Tag: <input style="width: 100%;" type="text"/> Type of instrument: <input style="width: 100%;" type="text"/> Manufacturer: <input style="width: 100%;" type="text"/> Model Number: <input style="width: 100%;" type="text"/> Serial No: <input style="width: 100%;" type="text"/> Certificate Number: <input style="width: 100%;" type="text"/> Certifying Authority: <input style="width: 100%;" type="text"/> Protection Type: <input style="width: 100%;" type="text"/>	Max Voltage Um: <input style="width: 50%;" type="text"/> V O/C Voltage Uo: <input style="width: 50%;" type="text"/> V S/C Current Io: <input style="width: 50%;" type="text"/> mA Power Po: <input style="width: 50%;" type="text"/> mW Allowable Cap. Co: <input style="width: 50%;" type="text"/> uF Allowable Ind. Lo: <input style="width: 50%;" type="text"/> mH L/Ro: <input style="width: 50%;" type="text"/> uH/Ohm

Cables:		
Cable 1: Tag: <input style="width: 100%;" type="text"/> Capacitance: <input style="width: 50%;" type="text"/> uF/m Inductance: <input style="width: 50%;" type="text"/> mH/m L/Rc: <input style="width: 50%;" type="text"/> mH/Ohm Length(D1): <input style="width: 50%;" type="text"/> m	Cable 2: Tag: <input style="width: 100%;" type="text"/> Capacitance: <input style="width: 50%;" type="text"/> uF/m Inductance: <input style="width: 50%;" type="text"/> mH/m L/Rc: <input style="width: 50%;" type="text"/> mH/Ohm Length(D2): <input style="width: 50%;" type="text"/> m	Total Cable: Capacitance: <input style="width: 50%;" type="text"/> uF Inductance: <input style="width: 50%;" type="text"/> mH Max L/Rc: <input style="width: 50%;" type="text"/> mH/Ohm

I.S. Apparatus Parameters (Hazardous Area):	
Tag: <input style="width: 100%;" type="text"/> Type of instrument: <input style="width: 100%;" type="text"/> Manufacturer: <input style="width: 100%;" type="text"/> Model Number: <input style="width: 100%;" type="text"/> Serial No: <input style="width: 100%;" type="text"/> Certificate Number: <input style="width: 100%;" type="text"/> Certifying Authority: <input style="width: 100%;" type="text"/> Protection Type: <input style="width: 100%;" type="text"/>	O/C Voltage Ui: <input style="width: 50%;" type="text"/> V S/C Current li: <input style="width: 50%;" type="text"/> mA Power Pi: <input style="width: 50%;" type="text"/> mW Capacitance Ci: <input style="width: 50%;" type="text"/> uF Inductance Li: <input style="width: 50%;" type="text"/> mH

Checks:		PASS/FAIL/NA
1	Uo <= Ui	<=
2	Io <= li	<=
3	Po <= Pi	<=
4	Ci+C _{Cable} <= Co	<=
6	Li+L _{Cable} <= Lo	<=
OR		
7	L/R _{Cable} < L/Ro	<
Conclusion:	The circuit IS Loop Calculation <input style="width: 100%;" type="text"/>	

- Notes:
- 1- Calculation is based on AS.NZS 2381.1:2005, AS2381.7-1989 & AS/NZS 60079.25:2004 for a single power supply loop in an intrinsically safe system.
 - 2- The I.S. Barrier is an integral part of the discrete input wireless transmitter.
 - 3- The above calculation, check and conclusion are also applicable to wireless transmitter LSL and LSL level switch I.S. circuits used for pump 1161C/D, 1162C/D, 1163C/D and 1164C/D sealoil pots.
 - 4- The level switch in this I.S. Circuit is classified as simple device.

APPENDIX A
DETERMINATION OF EXTERNAL CIRCUIT PARAMETERS
FOR INTRINSICALLY SAFE SYSTEMS

(This Appendix forms an integral part of this Standard.)

A1 CERTIFICATION METHODS. As specified in Clause 1.4, intrinsically safe electrical equipment may be certified under one of three categories as follows:

- (a) *Self-contained equipment.* Since this equipment has no external cabling, there are no external parameters to be specified, and hence, such equipment will not be considered further in this Appendix.
- (b) *Entity concept equipment.*
- (c) *Integrated systems.*

A2 PARAMETERS TO BE DEFINED.

A2.1 Entity concept equipment. For certified entity concept equipment the following parameters should be defined:

- (a) *Associated electrical equipment.*
 - (i) Maximum open circuit voltage (U_o).
 - (ii) Maximum output current (I_o).
 - (iii) Maximum external capacitance (C_o).
 - (iv) Maximum external inductance (L_o).
 - (v) Maximum external connected inductance to resistance ratio (L/R).
- (b) *Intrinsically safe equipment.*
 - (i) Maximum input voltage (U_i).
 - (ii) Maximum input current (I_i).
 - (iii) Maximum internal capacitance (C_i).
 - (iv) Maximum internal inductance (L_i).

The parameters are marked on the equipment or specified in the accompanying documentation.

A2.2 Integrated systems. For integrated systems, either one of the following cable parameters should be defined:

- (a) Maximum capacitance, inductance, and inductance to resistance ratio.
- (b) Maximum cable lengths for defined cable types.

These parameters are specified in the system documentation or the certificate.

A3 INSTALLATION OF ENTITY CONCEPT EQUIPMENT. For entity concept equipment to be installed, the total of the cable parameters and those for the intrinsically safe equipment shall be less than those permitted to be connected to the associated electrical equipment, i.e.

- (a) $C_i + C_{\text{cable}} < C_o$; and
- (b) either $L_i + L_{\text{cable}} < L_o$, or $L/R_{\text{cable}} < L/R$.

Also, the voltage and current allowed for the intrinsically safe equipment shall be greater than those available from the associated electrical equipment, i.e. $U_i > U_o$; $I_i > I_o$.

Where shunt diode safety barriers are being used and their capacitance, inductance and L/R ratio parameters have not been specified in the documentation, the values specified in Table A1 may be used.

A4 INSTALLATION OF INTEGRATED SYSTEMS. For an integrated system to be installed correctly, the cable characteristics shall be below those specified in the system certification, i.e. the total cable capacitance and either the total lumped cable inductance or the L/R ratio must be less than those shown in the certificate or installation diagram. Cable characteristics may be obtained from the manufacturer or the values specified in Tables A2 and A3 may be used.

Alternatively, the following cable characteristics represent probable maximums:

- (a) $C = 0.11 \mu\text{F}/\text{km}$.
- (b) $L = 0.8 \text{ mH}/\text{km}$.
- (c) $L/R = 56 \mu\text{H}/\Omega$.

If the parameters are only specified in the system certification for Group IIC they may be multiplied by 3 for Group IIB, by 8 for Group IIA, or by 10 for Group I installations.

Where the system documentation specifies cable types and corresponding lengths it is simply a matter of adhering to those specific requirements.

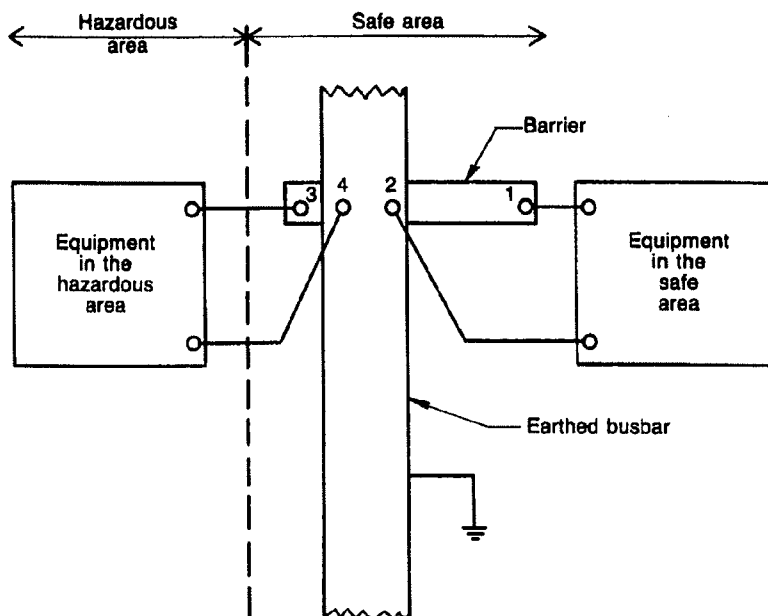
TABLE A1
EXTERNAL PARAMETERS
MAXIMUM VALUES FOR GROUP IIC (HYDROGEN)*

Barrier type	Permissible configuration	Max. permissible capacitance μF	Max. permissible inductance mH	Max. permissible L/R ratio $\mu\text{H}/\Omega$
27 V 270 Ω	Figure A1	0.15	3.7	55
22 V 150 Ω	Figure A1	0.2	1.5	40
15 V 100 Ω	Figure A1	0.8	1.5	60
	Figure A2	0.8	1.5	60
10 V 47 Ω	Figure A1	3.0	1.0	80
	Figure A2	3.0	1.0	80
	Figure A3	0.2	1.0	40
47 V 10 Ω	Figure A1	>1 000	0.16	100
	Figure A2	>1 000	0.16	100
	Figure A3	3.0	0.16	50
1 V 2 Ω	Figure A1	>1 000	0.16	320
	Figure A2	>1 000	0.16	320
	Figure A3	>1 000	0.16	160

* For most practical purposes, the value for gases of Group IIB are 3 times these values, and for gases of Group IIA are 8 times these values.

† The L/R ratio of the cable is defined as follows:

$$L/R \text{ ratio} = \frac{\text{Inductance per unit length } (\mu\text{H})}{\text{Resistance per unit length } (\Omega)}$$



NOTE: Barrier can be either positive or negative.

FIGURE A1 INSTALLATION CONFIGURATION 2-WIRE SYSTEM
WITH SINGLE BARRIER

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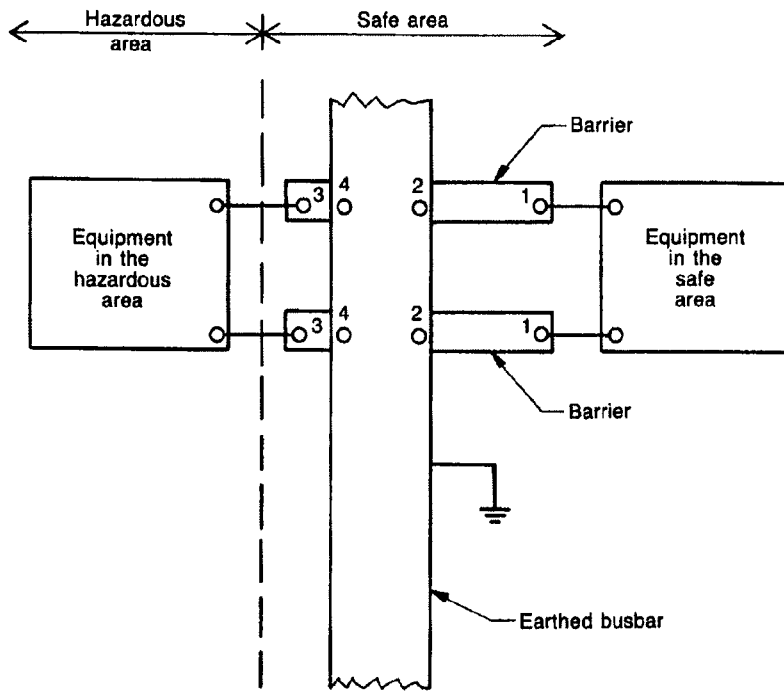


FIGURE A2 INSTALLATION CONFIGURATION 2-WIRE SYSTEM WITH TWO BARRIERS OF LIKE POLARITY

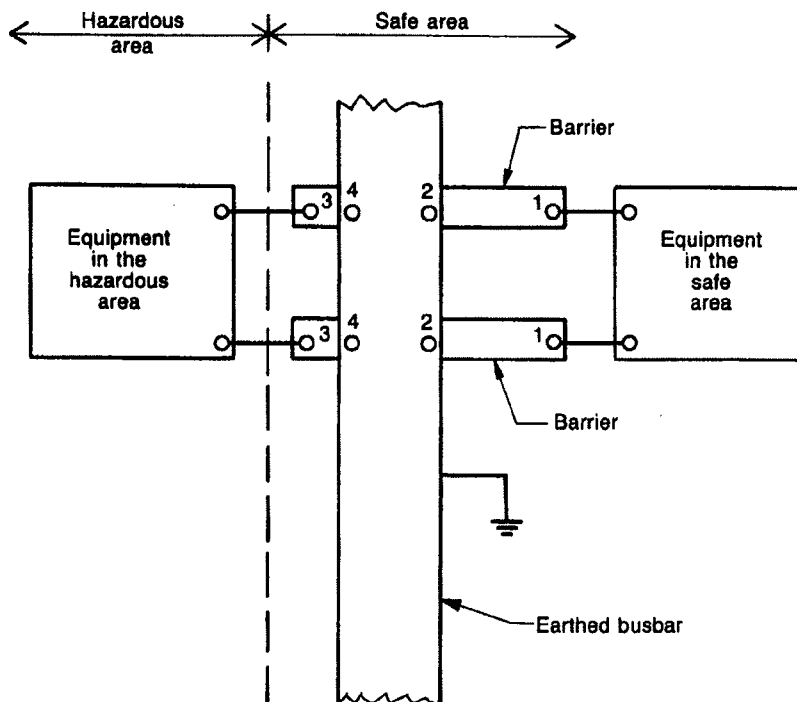


FIGURE A3 INSTALLATION CONFIGURATION 2-WIRE SYSTEM WITH TWO BARRIERS OF OPPOSITE POLARITY

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TABLE A2
TYPICAL CABLE CHARACTERISTICS FOR PVC CABLES WITH 0.3 mm
RADIAL THICKNESS

Nominal conductor size, number and dia. of wires	7/0.3 mm (0.5 mm ²)		7/0.5 mm (1.5 mm ²)	
	Screened	Unscreened	Screened	Unscreened
Conductor resistance at 20°C (Ω/100 m)	3.8	3.8	1.4	1.4
Capacitance of pairs (μF/km)	0.145	0.090	0.2	0.12
Inductance at 1 kHz (mH/km)	0.9	0.9	0.8	0.8
L/R ratio (μH/ohm)	12	12	31	31

TABLE A3
TYPICAL CABLE CHARACTERISTICS FOR
2-CORE MICC CABLE

Nominal conductor size (mm ²)	1
Conductor resistance single core (Ω/100 m)	3.45
Capacitance of pairs (μF/km)	0.1194
Capacitance, conductor to earth (μF/km)	1.1612
Inductance at 1 kHz (mH/km)	0.684
L/R ratio (μH/ohm)	20

APPENDIX C
SELECTION OF Ex e COMPONENTS
(Normative)

C1 GENERAL Each enclosure is allocated a permissible maximum dissipating power, expressed in watts, taking into account—

- (a) the dissipation per component for a given cable conductor size;
- (b) the size of each cable used and the resistance of its length, equal to the diagonal of the enclosure;
- (c) the maximum allowable current for the Ex e component or the maximum current allowable for each cable, if below the maximum allowable for the terminal block; and
- (d) the bunching of cables within each enclosure and the effect this has in producing 'hot spots'.

The selection of an acceptable combination in any assembly is based upon the requirement that enclosures shall not exceed a specified total dissipation of power (in watts) from the cables and the components which are to be housed within each enclosure.

The permissible maximum dissipating power (*MDP*) for the temperature classification of the enclosure, determined by test, will appear on the manufacturer's rating plate, e.g. 15.5 W.

Having established maximum dissipation of power from the enclosures, the wired assembly may be expressed in power loss in the following way:

$$\text{Dissipation per terminal: } P = I^2[R_t + L \times R_c] \quad \dots \text{E(1)}$$

$$P = I^2[R_t + R_d] \quad \dots \text{E(2)}$$

where

P = power dissipation, in watts

I = current through terminal (max. allowable or limited by cable size)

R_t = internal resistance of terminal, in ohms

R_c = cable resistance per metre, in ohms

L = length of cable equal to the diagonal of the enclosure, in metres

MDP = maximum dissipating power, in watts—the sum total of all terminals and wiring within the enclosure

R_d = resistance of a length of cable equal to the diagonal of the enclosure

Therefore, for a combination of terminals and cables the watts loss can be calculated from the basic test information and cable data as follows:

$$MDP = aP_1 + bP_2 + cP_3 \dots + zP_n \quad \dots \text{E(3)}$$

where

aP₁; *bP₂*; *cP₃*, ... *zP_n* represent the heat dissipation of different combinations and numbers (*a*; *b*; *c* ... *z*) of terminals and cables.

C2 EXAMPLE: SELECTION OF TERMINAL BLOCKS FOR COMPLIANCE WITH T6 CLASSIFICATION

Assume that the following is derived from tests:

Enclosure *MDP* = 15 watt

Terminal block TBK2.5 = 15 A max.

Terminal block TBK16 = 47 A max.

L = 270 mm

A. **P (TBK2.5) for**

P_1 3 amps 0.5 mm² cable = 0.092 W

P_2 12 amps 1.0 mm² cable = 0.763 W

P_3 15 amps 2.5 mm² cable = 0.530 W

B. **P (TBK16) for**

P_4 47 amps 16 mm² cable = 0.790 W

Maximum number of allowable terminals:

$$P_1 \text{ only} = \frac{15.0}{0.092} = 163; \text{ or}$$

$$P_2 \text{ only} = \frac{15.0}{0.763} = 19; \text{ or}$$

$$P_3 \text{ only} = \frac{15.0}{0.530} = 28; \text{ or}$$

$$P_4 \text{ only} = \frac{47.0}{0.790} = 59;$$

Now assume the following combination of terminals—

$$(60 \times P_1) + (6 \times P_2) + (3 \times P_3) + (3 \times P_4)$$

$$(60 \times 0.092) + (6 \times 0.763) + (3 \times 0.530) + (3 \times 0.790)$$

Total Heat Dissipation is—

$$5.52 + 4.578 + 1.590 + 2.37 = \mathbf{14.058 \text{ Watt}}$$

It is concluded that the combination of terminals and cables does not exceed MDP of 15 W and is therefore satisfactory for T6.

NOTE: The cables should not be bunched in quantities greater than the number of cores from each cable or conduit entering the enclosure and in any case should not exceed six per bunch.

C3 CABLE SELECTION v TERMINAL SELECTION The maximum current density permitted in any conductor inside or outside the enclosure is to be established as though the conductors are insulated with V75 material and enclosed in conduit in air and derated according to the ambient temperature and in any case not less than 50°C as established according to AS 3008.1. Additional derating factors may be necessary where bunching of cables occurs.

However, where the cables are run in situations that allow an increase of current-carrying capacity, the Ex e installation is placed at risk, particularly when the cable enters the terminal enclosure.

It is important to keep in mind that—

- (a) the Ex e terminal block rated current must not be exceeded; and
- (b) the cable connected to each terminal block is of a size acceptable to that block and the current carried by that cable complies with the requirements of Clause 2.7.2.

C4 FACTORS TO BE CONSIDERED IN SELECTING EQUIPMENT CERTIFIED

TO Ex e The establishment of criteria which can lead to practical installation of terminal boxes for use in Class I, Zones 1 and 2 hazardous areas can only be made by testing and from the tests a manufacturer can tabulate and mark—

- (a) maximum power for each enclosure to meet the temperature class—generally T6 or as certified;
- (b) maximum current per Ex e terminal—marked thereon, in amps;
- (c) resistance per terminal, in ohms;
- (d) average length per conductor—box diagonal in metres;
- (e) resistance per conductor length, in ohms;
- (f) actual load current per terminal for the installation in amps; and
- (g) maximum current per conductor, in amps in accordance with AS 3008.1.

For a particular manufacturer's terminal box, these criteria lead to the following tabulations:

TABLE C1
CONDUCTOR RESISTANCE PER BOX FOR EACH CONDUCTOR SIZE

Size mm ²	Enclosure types				
	No. 1	No. 2	No. 3	No. 4	No. 5
0.5	$\frac{\text{ohms}/1000\ m \times L}{1000}$ where <i>L</i> is in metres				
1.0					
2.5					
4.0					
6.0					
10.0					
16.0					
25.0					
35.0					
50.0					
70.0					
95.0					

TABLE C2
TERMINAL/COMPONENT RESISTANCE (*R*)

Component type	Average resistance (ohms)
TBK 2.5	Determined by test
TBK 4	
TBK 6	
TBK 10	
TBK ... <i>n</i>	

From Tables C1 and C2, details for each enclosure can be derived:

Assume Enclosure type box No. 1. **MDP = 15 watt**

Ex e component			Cable	Total
Type	Qty	Load or rating A	mm ²	W
TBK 2.5	60	3.0	0.5	5.52
TBK 2.5	6	12.0	1.0	4.578
TBK 2.5	3	15.0	2.5	1.590
TBK 16	3	47.0	16.0	2.37
Enclosure Total =				14.058

It is possible to determine a large variety of enclosure combinations for different components, given—

- (a) conductor resistance;
- (b) component resistance;
- (c) current drawn through each cable and component; and
- (d) enclosure MDP.

The manufacturer should be able to supply details of certified components and enclosures. Cable resistances are readily available from tables or the enclosure manufacturer may provide the values for each enclosure size and each cable length, equal to the enclosure diagonals.

C5 ENCLOSURE CONTENTS AND LABEL Having established the contents for each enclosure for a known application, it is important that any spare space within is **not** filled at some later stage with equipment which—

- (a) exceeds the certified MDP;
- (b) is not certified Ex e; or
- (c) arcs or sparks.

The user or the supplier should attach to the inside of the enclosure a label showing—

- (i) certified MDP;
- (ii) original component contents; and
- (iii) calculated total power dissipation of original installed components.

If the user changes the contents, it would be his responsibility to secure a revised list, having first established that the enclosure temperature class and certified MDP will not be exceeded by the proposed changes.

8 Manufacturer's Data Report (MDR) & Installation, Operation and Maintenance (IOM) Manual

Documentation in relation to this section is to be included and maintained by APA Group.

9 Maintenance Records

Documentation in relation to this section is to be included and maintained by APA Group.
This section includes sample maintenance sheet.



FYFE
Earth Partners
ENVIRONMENT
DEVELOPMENT
RESOURCES

MAINTENANCE REGISTER

APA Group

Site:

DATE	DESCRIPTION	ASSOCIATED TAGS	DOSSIER UPDATE AS REQUIRED (YES / NO / NA)								REMARKS
			P&ID	DATASHEET	HA EQUIPMENT REGISTER	CERTIFICATE OF CONFORMITY	INSTALLATION CHECK LIST	REPAIR & EXAMINATION REPORT	HA CLASSIFICATION	HA DRAWING	

10 Inspection Records

Close visual inspection to confirm equipment installations was performed by Daniel Williams, a sub-contract industrial/commercial electrician from Sitzler during a site visit on 4 August 2011.

This visit confirmed the site did not contain electrical equipment.

The Section contains sample inspection sheet(s) for future inspection.

Documentation in relation to this section is to be maintained by APA Group.

INSPECTION CHECK SHEET
Intrinsically Safe Ex i



TAG/IDENTIFICATION	DESCRIPTION									
Area Classification - Zone 0 1 2 20 21 22 Non Hazardous - Group I IIA IIB IIC - Temp T1 T2 T3 T4 T5 T6										
Record Name Plate Details							Record other nameplate information that may be relevant			
Manufacturer		Vin		Chin						
Serial No.		Lin		Lin						
Model										
Certificate no.		T		IP						
Certifying authority										
Inspection Type Performed (I=Initial, P=Periodic, S=Sample)						I	P	S		
Inspection Grade Performed (D=Detailed, C=Close, V=Visual)						D	C	V	Detailed requires de-energization	
Equipment Y=OK, N=Not Acceptable, N/A=Not Applicable, N/C=Not Checked							Inspect Grade	Remarks		
Equipment is Australian or IEC Certified	Y	N	N/A	N/C	DCV					
EX markings are suitable for the area	Y	N	N/A	N/C	DCV					
Equipment is clearly marked and has appropriate tag/identification details	Y	N	N/A	N/C	DCV					
Enclosure is not damaged and maintains its weatherproofing	Y	N	N/A	N/C	DCV					
Terminations are tight	Y	N	N/A	N/C	DC					
All unused conductors terminated	Y	N	N/A	N/C	DC					
Bolts, bungs, plugs/blank plates installed and tight	Y	N	N/A	N/C	DCV					
Fuses and lamps are correct rating	Y	N	N/A	N/C	DCV					
No unauthorised modifications (Y=OK)	Y	N	N/A	N/C	DCV					
Installation							Grade	Remarks		
Cable type is as per the documentation	Y	N	N/A	N/C	D					
IS Entity and cable parameters are suitable for installation	Y	N	N/A	N/C	D					
The device is securely mounted	Y	N	N/A	N/C	DC					
Cables/conduits in acceptable condition	Y	N	N/A	N/C	D					
Cables/conduit entry correct, complete, and tight	Y	N	N/A	N/C	DCV					
No excessive vibration present that may cause conductors to work loose (Y=OK)	Y	N	N/A	N/C	DCV					
Segregation between IS and non IS circuits at junction boxes	Y	N	N/A	N/C	DCV					
Segregation between IS and non IS circuits in cable ladder and conduit	Y	N	N/A	N/C	DCV					
Earthing and equipotential bonding satisfactory	Y	N	N/A	N/C	D					
Insulation resistance is satisfactory (NB Danger of MEGGER testing HA)	Y	N	N/A	N/C	D					
Cable screens earthed as per documentation (normally one point only)	Y	N	N/A	N/C	D					
Barriers							Grade	Remarks		
Record Safety Barriers manufacturer and model no. (available on device = Y)	Y	N	N/A	N/C	DC					
Equipment is Australian or IEC Certified (Enter certification details in 'Remarks')	Y	N	N/A	N/C	DCV					
Record Safety Barriers certification details (available on device = Y)	Y	N	N/A	N/C	DC					
Safety Barriers are the correct type as per the drawings	Y	N	N/A	N/C	DC					
Safety Barriers are securely connected to the earth bar	Y	N	N/A	N/C	DCV					
Barrier/Isolator terminations are tight	Y	N	N/A	N/C	DCV					
Maximum voltage on the safe side of the barrier/isolator is 240V	Y	N	N/A	N/C	DCV					
IS circuits are all free from external power circuit infiltration	Y	N	N/A	N/C	DCV					
No energy storing devices in excess of the max energy permitted	Y	N	N/A	N/C	DC					
Relays acting as safety barriers are in good condition	Y	N	N/A	N/C	DCV					
Earth continuity from barrier bar to the transformer neutral point is <1ohm	Y	N	N/A	N/C	D		Check one connection at a time			
Environment							Grade	Remarks		
Equipment adequately protected against corrosion, weather, vibration, etc	Y	N	N/A	N/C	DCV					
Dust and dirt on the equipment and cable are within acceptable limit	Y	N	N/A	N/C	DCV					
Special conditions							Grade	Remarks		
Special conditions on certificate are satisfied	Y	N	N/A	N/C	D					
Notes:										
Inspected: _____ Date: _____ Checked: _____ Date: _____										

INSPECTION CHECK SHEET

Increased Safety Ex e



TAG/IDENTIFICATION	DESCRIPTION										
Area Classification - Zone 0 1 2 Non Hazardous - Group I IIA IIB IIC - Temp T1 T2 T3 T4 T5 T6											
Record Name Plate Details						Record other nameplate information that may be relevant					
Manufacturer		KW		FLC							
Serial No.		Volts		RPM							
Model											
Certificate No.		T		IP							
Certifying authority											
Inspection type performed (I=Initial, P=Periodic, S=Sample)				I	P	S					
Inspection Grade Performed (D=Detailed, C=Close, V=Visual)				D	C	V	Detailed requires de-energization				
Equipment Y=OK, N=Not Acceptable, N/A=Not Applicable, N/C=Not Checked						Inspect Grade	Remarks				
Equipment is Australian or IEC Certified				Y	N	N/A	N/C	DCV			
EX markings are suitable for the area				Y	N	N/A	N/C	DCV			
Equipment is clearly marked and has appropriate tag/identification details				Y	N	N/A	N/C	DCV			
Enclosure is not damaged and maintains its weatherproofing (min IP54)				Y	N	N/A	N/C	DCV			
Enclosure gaskets are in a satisfactory condition				Y	N	N/A	N/C	D			
Bolts, bungs, plugs/blank plates installed and tight				Y	N	N/A	N/C	DCV			
Terminals are sized correctly for the rating				Y	N	N/A	N/C	D			
Conductors > 0.5mm ² for multistranded and 1mm ² for single strand				Y	N	N/A	N/C	D			
No chafing parts that may cause local hot spots (motor fans) (Y=OK)				Y	N	N/A	N/C	D			
Guards are correctly fitted				Y	N	N/A	N/C	D			
No unauthorised modifications (Y=OK)				Y	N	N/A	N/C	DCV			
Lamp rating, type and position are correct				Y	N	N/A	N/C	D			
Installation						Grade	Remarks				
Equipment carries correct circuit identification at switchboard and local isolator				Y	N	N/A	N/C	D			
Effective means of isolation of all live conductors (including neutral)				Y	N	N/A	N/C	D			
Installation is in compliance with documentation				Y	N	N/A	N/C	DC			
Cable type is as per the documentation				Y	N	N/A	N/C	D			
The device is securely mounted				Y	N	N/A	N/C	DCV			
Cables/conduits in acceptable condition				Y	N	N/A	N/C	DCV			
Cables/conduit entry correct, complete, and tight (Exd or Exe glands used)				Y	N	N/A	N/C	DCV			
Exd glands have additional weatherproofing				Y	N	N/A	N/C	DCV			
Electrical connections are tight				Y	N	N/A	N/C	D			
Creepage and clearance distance are maintained				Y	N	N/A	N/C	D			
All unused conductors terminated in Exe terminals				Y	N	N/A	N/C	D			
Earthing and equipotential bonding satisfactory				Y	N	N/A	N/C	DCV			
Insulation resistance is satisfactory (NB Danger of MEGGER testing HA)				Y	N	N/A	N/C	D			
Motor parameters (Ia/In and te) and TOLs coordinate (record TOL mfr/model)				Y	N	N/A	N/C	D			
Cable Glands and adaptors						Grade	Remarks				
Cable glands details available, record (available=Y, not recorded=N/C)				Y	N	N/A	N/C	DCV			
Cable glands certificate details available, record (available=Y, not recorded=N/C)				Y	N	N/A	N/C	DCV			
Adaptors and plugs details available, record (available=Y, not recorded=N/C)				Y	N	N/A	N/C	DC			
Glands and adaptors Ex markings are suitable for area				Y	N	N/A	N/C	DCV			
Environment						Grade	Remarks				
Equipment adequately protected against corrosion, weather, vibration, etc				Y	N	N/A	N/C	DCV			
Dust and dirt on the equipment and cable are within acceptable limit				Y	N	N/A	N/C	DCV			
Special conditions						Grade	Remarks				
Special conditions on certificate are satisfied				Y	N	N/A	N/C	D			
Notes:											
Inspected: _____ Date: _____ Checked: _____ Date: _____											

Hazardous Area Check Sheet Flameproof Ex d



TAG/IDENTIFICATION	DESCRIPTION											
Area Classification - Zone 0 1 2 Non Hazardous - Group I IIA IIB IIC - Temp T1 T2 T3 T4 T5 T6												
Record Name Plate Details						Record other nameplate information that may be relevant						
Manufacturer		KW		FLC								
Serial No.		Volts		RPM								
Model												
Certificate No.		T		IP								
Certifying authority												
Inspection Type Performed (I=Initial, P=Periodic, S=Sample)					I	P	S					
Inspection Grade Performed (D=Detailed, C=Close, V=Visual)					D	C	V	Detailed requires de-energization				
Equipment Y=OK, N=Not Acceptable, N/A=Not Applicable, N/C=Not Checked							Inspect Grade	Remarks				
Equipment is Australian or IEC Certified					Y	N	N/A	N/C	DCV			
EX markings are suitable for the area					Y	N	N/A	N/C	DCV			
Equipment is clearly marked and has appropriate tag/identification details					Y	N	N/A	N/C	DCV			
Enclosure is not damaged and maintains its flameproof characteristics					Y	N	N/A	N/C	DCV			
Locking sealing, fastening devices are of type certified by manufacturer					Y	N	N/A	N/C	DCV			
Locking sealing, fastening devices operate correctly and are tight					Y	N	N/A	N/C	DC			
Bolts, bungs, plugs/blank plates installed and tight					Y	N	N/A	N/C	DCV			
Sealing gaskets and components in acceptable condition					Y	N	N/A	N/C	DCV			
Flange faces are clean and undamaged					Y	N	N/A	N/C	D			
Flange gap dimensions are less than _____ mm					Y	N	N/A	N/C	DC			
No unauthorised modifications (Y= OK)					Y	N	N/A	N/C	DCV			
Equipment is clear of obstructions (minimum dimensions 40mm)					Y	N	N/A	N/C	DCV			
No chafing parts that may cause local hot spots (motor fans) (Y=OK)					Y	N	N/A	N/C	D			
Guards are correctly fitted					Y	N	N/A	N/C	D			
Lamp rating, type and position are correct					Y	N	N/A	N/C	D			
Installation							Grade	Remarks				
Equipment carries correct circuit identification at switchboard and local isolator					Y	N	N/A	N/C	D			
Effective means of isolation of all live conductors (including neutral)					Y	N	N/A	N/C	D			
Cable type is as per the documentation					Y	N	N/A	N/C	D			
The device is securely mounted					Y	N	N/A	N/C	DCV			
Cables/conduits in acceptable condition					Y	N	N/A	N/C	DCV			
Cables/conduit entry correct, complete, and tight with sufficient threads					Y	N	N/A	N/C	DCV			
Sealing of conduits, ducts or other connections is satisfactory					Y	N	N/A	N/C	D			
Integrity of conduit system and mixed system interface satisfactory					Y	N	N/A	N/C	D			
Earthing and equipotential bonding satisfactory					Y	N	N/A	N/C	DCV			
Insulation resistance is satisfactory (NB Danger of MEGGER testing HA)					Y	N	N/A	N/C	D			
Protection devices (Limit sws, phase rot, TOLs) operate correctly					Y	N	N/A	N/C	D			
Cable Glands and adaptors							Grade	Remarks				
Cable glands details available, record (available=Y, not recorded=N/C)					Y	N	N/A	N/C	DCV			
Cable glands certificate details available, record (available=Y, not recorded=N/C)					Y	N	N/A	N/C	DCV			
Adaptors and plugs details available, record (available=Y, not recorded=N/C)					Y	N	N/A	N/C	D			
Adaptors and plugs have sufficient engaged threads					Y	N	N/A	N/C	DCV			
Glands and adaptors Ex markings are suitable for area					Y	N	N/A	N/C	DCV			
Environment							Grade	Remarks				
Equipment adequately protected against corrosion, weather, vibration, etc					Y	N	N/A	N/C	DCV			
Dust and dirt on the equipment and cable are within acceptable limit					Y	N	N/A	N/C	DCV			
Special conditions							Grade	Remarks				
Special conditions on certificate are satisfied					Y	N	N/A	N/C	D			
Notes:												
Inspected: _____ Date: _____ Checked: _____ Date: _____												

11 Overhaul, Repair, Modification and Replacement Records

This Section contains the sample repair and examination report(s).

Documentation in relation to this section is to be maintained by APA Group.

REPAIR AND EXAMINATION REPORT FOR INTRINSICALLY SAFE EQUIPMENT (EX 'i')



General

Tag no.:	Site:
P&ID:	Area Classification:

Equipment Details

Equipment type:	Gas group (IIA/B/C):
Manufacturer:	Temp class (T1-T6):
Model no.:	Certificate no.:
Serial no.:	Test authority:

Competent Operator

Name:	Identification no.:
Company:	Company registration:

Condition

Condition upon receipt:
Old repair label details:
Reported Fault (if any):

Action

Repair action:.....
Remarks:.....

I,.....confirm that the above equipment, repaired/overhaul/modified (strike out whichever is not applicable) as above, complies/does not comply with the relevant requirements of AS/NZS 3800 (including markings as required by Appendix D) and AS.....and that this Report has been recorded in the logbook of the service facility.

Sign:..... Date:...../...../.....

REPAIR AND EXAMINATION REPORT FOR INCREASED SAFETY ENCLOSURES (EX 'e')



General

Tag no.:	Site:
P&ID:	Area Classification:

Equipment Details

Equipment type:	Gas group (IIA/B/C):
Manufacturer:	Temp class (T1-T6):
Model no.:	Certificate no.:
Serial no.:	Test authority:

Competent Operator

Name:	Identification no:
Company:	Company Registration:

Enclosure Condition

Old repair label no.:		
External surface cleaned for inspection - Yes / No		
Covers and fasteners:	Base of enclosure:	
Threaded holes:	External corrosion:	
Surface coating:	Gland entries and glands:	
General external condition:		
Enclosure dismantled:	Degree of protection: IP	
Internal Condition - Dust/Liquids:	Corrosion:	Heat:
Missing parts:		
Cables and terminations:	Terminal blocks:	
Earth terminals:	Insulation:	
Windows and seals:	Actuators and seals:	
Ex 'de' parts:	Meters:	
Lamps:	Transformers:	
Switches:	Others:	
Relays:	Interlocks:	
Luminaire:	Lamp power (W):	
Transparent part:	Lampholders:	
Ballasts:	Capacitors:	Batteries:

Action

Repair
.....
Remarks:.....
.....

I,.....confirm that the above equipment, repaired/overhaul/modified (strike out whichever is not applicable) as above, complies/does not comply with the relevant requirements of AS/NZS 3800 (including markings as required by Appendix D) and AS.....and that this Report has been recorded in the logbook of the service facility.

Sign:.....

Date:...../...../.....

REPAIR AND EXAMINATION REPORT FOR ELECTRICAL EQUIPMENT INSTALLED WITHIN FLAMEPROOF ENCLOSURE (EX'd')



General

Tag no.:	Site:
P&ID:	Area Classification:

Equipment Details

Equipment type:	Gas group (IIA/B/C):
Manufacturer:	Temp class (T1-T6):
Model no.:	Certificate no.:
Serial no.:	Test authority:

Operator

Name:	Identification no.:
Company:	Company registration:

Equipment Condition Checklist

Item	Description of check	No work	Repaired	Replaced
(a)	Isolator mechanism and switch operation			
(b)	Earthing device and operation			
(c)	All auxiliary mechanisms, trip bars, latching arrangements, etc.			
(d)	All locking devices, function and operation			
(e)	All parts for mechanical condition			
(f)	All insulation checked – no heat, cracks, etc.			
(g)	Phase barriers fitted correctly and functional			
(h)	Oil levels and/or gas pressure			
(i)	Gas pressure-sensing devices			
(j)	All wiring and terminations			
(k)	Earth continuity; phase/earth fault lock units			
(l)	Overcurrent, overload and earth-fault devices			
(m)	Earth-fault trip devices			
(n)	Timing devices			
(o)	Temperature-sensing devices			
(p)	Transformer connections, bolts, tapes, bracing, insulators and fittings, etc.			
(q)	Installation			
(r)	Machine cables and glands			

Details of repair or modification (attach extra pages if required):

Results of insulation resistance tests on transformers:

Transformers ratio:..... Capacity:..... Serial no.:.....

Manufacturer:..... Type of cooling:.....

Tested with:..... V (megohmmeter)

Primary winding to secondary winding:..... MΩ

Primary winding to earth:..... MΩ

Secondary winding to earth:..... MΩ

Earth continuity of earth screen to core:.....

Continued....

REPAIR AND EXAMINATION REPORT FOR ELECTRICAL EQUIPMENT INSTALLED WITHIN FLAMEPROOF ENCLOSURE (EX'd')



Assembled unit tested for insulation resistance with: V megohmmeter, and power frequency tested on the following circuits:

Circuit description	Insulation resistance MΩ	Test voltage kV	Test frequency Hz	Result

Certification no(s).....

Remarks:.....

I,.....confirm that the above equipment, repaired/overhaul/modified (strike out whichever is not applicable) as above, complies/does not comply with the relevant requirements of AS/NZS 3800 (including markings as required by Appendix D) and AS.....and that this Report has been recorded in the logbook of the service facility.

Sign:.....

Date:...../...../.....

REPAIR AND EXAMINATION REPORT FOR FLAMEPROOF ENCLOSURE (EX'd')



General

Tag no.:	Site:
P&ID:	Area Classification:

Equipment Details

Equipment type:	Gas group (IIA/B/C):
Manufacturer:	Temp class (T1-T6):
Model no.:	Certificate no.:
Serial no.:	Test authority:

Operator

Name:	Identification no.:
Company:	Company registration:

Equipment Condition Checklist

Item	Description of check	Remarks
(a)	Check of external and internal damage	
(b)	Dimensional check	
(c)	Corrosion on flamepaths	
(d)	Result of static pressure test	
(e)	Check of flanged joint surfaces	
(f)	Check of all threaded holes	
(g)	Check of all windows and lenses	
(h)	Check of breathers	
(i)	Check of all bolt holes, studs, screws,	
(j)	Check of all gland entries and fixing	
(k)	Check of all cables glands	
(l)	Check of all handhole and inspection	
(m)	Check of all mechanical interlocks	
(n)	Check of all flamepath gaps	

Main control panel

1. Max. out of plane of box flanges:.....
2. Max. out of plane of cover:.....
3. Max. flameproof gap when bolted up:.....
4. Max. diametral clearance of spindles:.....
5. Max. diametral clearance of gland to gland apertures:.....
6. Static pressure test – pressure:.....
7. Water jacket – pressure test:.....Capacity:.....

Certification drawing no(s):.....

Remarks:.....
.....
.....

I,.....confirm that the above equipment, repaired/overhaul/modified (strike out whichever is not applicable) as above, complies/does not comply with the relevant requirements of AS/NZS 3800 (including markings as required by Appendix D) and AS.....and that this Report has been recorded in the logbook of the service facility.

Sign:.....

Date:...../...../.....

12 Schedule of Equipment and Conditions Requiring Compliance Status Attention

This site does not contain electrical equipment in the hazardous area. As a result, a Schedule of Equipment and Conditions Requiring Compliance Status Attention is not required.