Department of Planning and Environment

Our ref: SSI-9471-PA-77

Alexandra Lovell
HSE Manager
Australian Industrial Energy
PO Box 1070
Wollongong, NSW, 2500

22/09/2022

Subject: Safety Management Study for Port Kembla Gas Terminal (SSI-9471)

Dear Ms. Lovell

I refer to your submission requesting review and approval of the Safety Management Study (SMS) and note that the SMS:

- has been conducted appropriately by all the relevant and necessary parties (DPE Energy Pipelines Team being one of the attendees);
- is consistent with *Australian Standard 2885 Pipelines – Gas and liquid petroleum (AS 2885)*; and
- considered the changes to accommodate SSI 9471 PKGT MOD 4.

It is also noted that the SMS scope covers the entirety of the new lateral pipeline route from the Port Kembla Gas Terminal (PKGT) to the existing Eastern Gas Pipeline (EGP – State Significant Infrastructure approval SSI 9973). The entirety of this route is divided into 2 segments as specified in SMS Section 1.1:

- Segment 1 – PKGT to the KP6.2 buried tie-in accordance with SSI 9471 up to MOD 3. Schedule 3, Condition 21e specifies the SMS requirements because the operator for this segment was uncertain at the time of assessment (i.e. AIE, Jemena or new entity). Jemena will be the operator for this segment and will tie-into Jemena's existing EGP licence under the *Pipelines Act 1967*; and
- Segment 2 – KP6.2 buried tied-in to EGP in accordance with SSI 9973 up to MOD 2. The SMS requirement is not specified in the consent because it was clear at the time of assessment that this segment will tie-into Jemena's existing EGP licence and be regulated under the *Pipelines Act 1967*, and therefore a SMS must be conducted for this segment by Jemena for the whole EGP to remain compliant under the Pipelines Act.

Notwithstanding, the Department reviewed the SMS for Segments 1 and 2, anticipating the lodgement of SSI 9471 PKGT MOD 4, which proposes some changes to Segment 1 operating conditions for compatibility with Segment 2 and the existing EGP.

The Department has carefully reviewed the document and is satisfied that it meets the requirements under SSI 9471 Schedule 3, Condition 21e up to MOD 3 only, subject to the Applicant ensuring that all relevant parties will complete all actions and implement all safeguards from the SMS in a timely and appropriate manner.

Accordingly, as nominee of the Planning Secretary, I approve the Safety Management Study (Rev 2, dated 18 July 2022).

Please ensure you make the document publicly available on the project website at the earliest convenience.

The Department expects that the SSI 9471 MOD 4 assessment will include a preliminary hazard analysis (PHA) incorporating the findings from the SMS.

If you wish to discuss the matter further, please contact Wayne Jones on (02) 6575 3406.

Yours sincerely

Stephen O'Donoghue
Director
Resource Assessments
As nominee of the Planning Secretary

Supplier Document Cover Sheet

GPA ENGINEERING	**Supplier PO/Contract No:**	4100297015
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Project Name:	**Project Marlin**			
Supplier Document Title:	Detailed Design SMS Report			
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Detailed Design SMS Report

Port Kembla Pipeline

Jemena Ltd

GPA Document No: 20617-REP-023
Client Document No: GAS-556-RP-RM-002

GPA Project No: 20617

Rev	Date	By	Checked	QA	Description
0	28/04/2022	ZAH	RMcD	JE	Issued for Use
1	17/06/2022	ZAH	RMcD	JE	Issued for Use (Updated to capture CL removal)
2	18/07/22	ZAH	RMcD	JE	Issued for Use

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EXECUTIVE SUMMARY

This report has been prepared for Jemena Asset Management Proprietary Limited (Jemena), and is subject to Jemena's approval in accordance with their obligations under AS 2885.0.

Jemena owns and operates the existing Eastern Gas Pipeline (EGP) including the existing Port Kembla Lateral Pipeline.

Australian Industrial Energy (AIE) plans to develop New South Wales' first liquefied natural gas (LNG) import terminal at Port Kembla near Wollongong. Once constructed, the Port Kembla Gas Terminal (PKGT) will have the capacity to deliver approximately 500 MMSCFD (520 TJ/d) of gas to the Jemena network.

A new ~12 km DN450 pipeline will be constructed between the Onshore Receiving Facility (ORF) at PKGT and a new meter station at Kembla Grange (Kembla Grange Meter Station) where it will connect to the EGP near the Kembla Grange mainline valve (MLV) station via hot tap. The ORF at PKGT will consist of the Marline Loading Arms (MLA) connecting the facility to the FSRU, pig launcher and odorant injection package. The Kembla Grange Meter Station will consist of a pig receiver, custody transfer metering skid and actuated shutdown valve. The new pipeline will be referred to as the Port Kembla Pipeline for the purposes of this Safety Management Study.

The governing legislation for majority of the length of the pipeline requires that the Port Kembla Pipeline complies with Australian Standard AS(/NZS) 2885: *Pipelines – Gas and liquid petroleum*. Although a section of the pipeline lies within NSW Ports owned land, and falls within the jurisdiction of Workcover legislation, it has been determined that application of AS 2885 is desirable as it represents best inudstry practice for pipeline design and operations. AS 2885 covers the design, construction, operation and maintenance of high pressure gas and liquid petroleum pipelines. It mandates a robust Safety Management Study (SMS) is maintained for pipelines to manage all potential threats to pipeline integrity.

This Detailed Design SMS report has reviewed the two discrete sections of the Port Kembla pipeline:

- Segment 1: From the AIE Onshore Receiving Station at the PKGT to the buried tie-in to Segment 2 at approximately KP6.2.

- Segment 2: From the buried tie-in to Segment 1 to the Kembla Grange Meter Station (KGMS) at approximately KP12. The Segment 2 alignment follows the existing Port Kembla Lateral Pipeline for majority of its route.

The Detailed Design SMS validation workshop for the Port Kembla Pipeline was facilitated by GPA Engineering and conducted via video-conference on 1 October 2021. The workshop considered the alignment as recorded in the Jemena Rev E (Segment 1) and Rev F (Segment 2) alignment sheets and the information and documentation listed in Appendix 1. The SMS Workshop did not identify any unusual threats that cannot be controlled through the current design process. Therefore, no significant impediments to meeting the requirements of AS(/NZS) 2885 were identified.

The primary location classification for the entire pipeline route is *Residential (T1)*, and the secondary location classification is *Heavy Industrial (HI)* for Segment 1 and *Industrial (I)* for Segment 2. For some of the pipeline route a secondary location classification of *Common Infrastructure Corridor (CIC)* is also applied. A *Sensitive Use (S)* location classification applies between approximately KP 8.6 to KP 9.8, to account for the proposal to develop a nearby "holistic health care precinct" which will include a hospital, palliative care facilities and an aged care centre. Additionally, the Coniston Public School was identified as being within the measurement length of the pipeline and a secondary location classification of *Sensitive (S)* was applied for this location between KP2.4 and KP3.2.

The entire route of the pipeline is *high consequence area*[1], to which the provisions for *high consequence areas* apply[2]. This report has determined that the provisions for *high consequence areas* (i.e. "no rupture" and maximum energy release rate) are achieved by virtue of the fact that no credible external interference threats were identified that could penetrate the pipeline.

The detailed workshop record and database report is included in Appendix 3.

A consolidated list of actions in included as Appendix 5. Confirmation that relevant actions are closed out prior to construction and commissioning shall be documented by the pre-construction and pre-commissioning SMS reviews in accordance with the requirements of AS/NZS 2885.6.

[1] Refer Clause 1.5.24, AS 2885.0.
[2] Refer Clause 4.9, AS/NZS 2885.1. See also discussion in Section 4.4 below.

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1 INTRODUCTION

1.1 BACKGROUND

Jemena owns and operates the existing Eastern Gas Pipeline including the existing Port Kembla Lateral Pipeline.

Australian Industrial Energy (AIE) plans to develop New South Wales' first liquefied natural gas (LNG) import terminal at Port Kembla near Wollongong. Once constructed, the Port Kembla Gas Terminal (PKGT) will have the capacity to deliver approximately 500 MMSCFD (520 TJ/d) of gas to the Jemena network.

A new ~12 km DN450 pipeline will be constructed between the Onshore Receiving Facility (ORF) at PKGT and a new meter station at Kembla Grange (Kembla Grange Meter Station) where it will connect to the EGP near the Kembla Grange mainline valve (MLV) station via hot tap. The ORF at PKGT will consist of the Marline Loading Arms (MLA) connecting the facility to the FSRU, pig launcher and odorant injection package. The Kembla Grange Meter Station will consist of a pig receiver, custody transfer metering skid and actuated shutdown valve.

The new pipeline is referred to as the Port Kembla Pipeline for the purposes of this Safety Management Study.

The Port Kembla Pipeline Project comprises two segments.

- Segment 1: From the AIE Onshore Receiving Station at the PKGT to the buried tie-in to Segment 2 at approximately KP6.2.

- Segment 2: From the buried tie-in to Segment 1 to the Kembla Grange Meter Station (KGMS) at approximately KP12. The Segment 2 alignment follows the existing Port Kembla Lateral Pipeline for majority of its route.

The Port Kembla Pipeline traverses a residential, light industrial and heavy industrial land uses, which includes parkland and community spaces at locations along the route.

There are seven HDD sections and one bored crossings within Segment 1. There are three HDD sections and one bored road crossing within Segment 2. The rest of the pipeline will be installed by normal trenching practices at a minimum depth of 1,200 mm unless otherwise specified in the alignment sheets.

The MAOP for the pipeline is 14.895 MPag in line with the existing EGP. However, the design pressure has been selected at 16.55 MPag to allow for future increases in the operating pressure of the EGP (as summarised in Jemena's EGP Operations Manual GTS-599-OM-GEN-001).

The governing legislation for majority of the length of the pipeline requires that the Port Kembla Pipeline complies with Australian Standard AS(/NZS) 2885: *Pipelines – Gas and liquid petroleum*. Although a section of the pipeline lies within NSW Ports owned land, and falls within the jurisdiction of Workcover legislation, it has been determined that application of AS 2885 is desirable as it represents best inudstry practice for pipeline design and operations. AS 2885 covers the design, construction, operation and maintenance of high pressure gas and liquid petroleum pipelines. It mandates a robust Safety Management Study (SMS) is maintained for pipelines to manage all potential threats to pipeline integrity.

An SMS has been undertaken in the Front End Engineering Design (FEED) phase of the project.

1.2 SCOPE AND OBJECTIVE

This Detailed Design SMS report covers PKP Segment 1 and Segment 2.

A map of the Port Kembla Pipeline is provided in Figure 1.

The objective of the Detailed Design SMS is to identify any pipeline features and threats that have not been controlled through the current design so that these can be accounted for prior to completion of the detailed design phase.

1.3 EXCLUSIONS

The SMS Brief document (Appendix 2A) and SMS workshop considered a short length of pipeline called the Cringila Lateral, that teed into the PKP at approximately KP 6.2, within the project scope. This lateral pipeline was for the purpose of conveying gaseous Nitrogen to blend with natural gas where dilution was needed for rich gas compositions. After the SMS workshop was completed this pipeline component was removed from the design, refer Appendix 3A of this report. References to this lateral are retained within this report and reference documentation for the purpose of completeness, however should be regarded as out of scope and not intended to be constructed. There will be no installation of any component of this lateral, although the design information has been retained for potential future use.

Australian Industrial Power (AIP) have proposed to build a new power plant at Port Kembla to be co-located with the new Port Kembla Gas Terminal at Port Kembla Wharf. The power plant will be designed for initial operation up to 30% blended hydrogen/natural gas, with the ability to transition to 100% hydrogen. There is a possibility that the PKP will supply the natural gas/hydrogen for the power plant.

This Detailed Design SMS has not considered the review of any specific threats with respect to operation of the pipeline in hydrogen service.

1.4 METHODOLOGY

The methodology for the SMS undertaken by GPA Engineering was in accordance with *AS/NZS 2885, Part 6 – Pipeline Safety Management*.

The workshop reviewed all available detailed design data that has been entered into the GPA Guardian SMS database, based on:

- Basic pipeline parameters
- Design calculations and drawings
- Design basis information
- Previous SMS studies
- Location classification data documented in the alignments sheets
- The current route and crossings information documented in the Jemena GIS
- Threat and control information that had been developed for the 2020 EGP Operational SMS (GAS-599-RP-RM-014).

The workshop was attended by key project, design, operations, maintenance and engineering personnel.

The workshop took place via video-conference on 1 October 2021.

Representatives of the following stakeholders were invited to the workshop:

- AIE
- GPA Engineering
- Jemena
- NSW Department of Planning, Industry and Environment
- SafeWork NSW
- Zinfra

1.5 PREVIOUS SAFETY MANAGEMENT STUDIES

In compiling this report and undertaking the SMS review process, GPA has considered the following reports:

- The preliminary design SMS for Segment 2, Doc No: 411010-00071-SR-REP-0001 – *Port Kembla Lateral Looping NGP2 Pipeline FEED.*
- The FEED SMS for Segment 1, Doc No: 401010-01496-PL-REP-002 – FEED PKGT Pipeline Safety Management Study Report.
- The FEED SMS report, Doc No: GAS-556-RP-RM-001 – Project Marlin FEED SMS Report
- The 2020 EGP Operational SMS (GAS-599-RP-RM-014)

2 OVERVIEW OF PIPELINE

2.1 PIPELINE ROUTE

The new approx. 12 km DN450 pipeline will be constructed between the AIE Onshore Receiving Facility (ORF) at the PKGT and a new meter station at the Kembla Grange Meter Station (KGMS) where it will connect to the EGP near the Kembla Grange mainline valve (MLV) station via hot tap. The route is shown in Figure 1 with alignment sheets referenced in Appendix 1.

Figure 1 – Port Kembla Pipeline Overview (Segment 1 in blue, Segment 2 in yellow)

2.2 PIPELINE DESIGN PARAMETERS

The design parameters for the PKP pipeline are provided in Table 1:

Table 1 – Port Kembla Pipeline Design Parameters

DESCRIPTION	VALUE	COMMENT
Nominal Diameter	DN450 (OD 457 mm)	
Length	~12 km	
MAOP	14,895 kPag	EGP MAOP. Typical delivery pressure to EGP will be ~9,000kPag
Design Pressure	16,550 kPag	Design pressure to allow for future MAOP upgrade of EGP
Wall Thickness (minimum)	13.5 mm	Minimum specified WT. Actual WT will be determined by availability of pipe.
Line Pipe	API 5L Grade X65 SMYS = 450 MPa	
Hoop Stress (design pressure)	280 MPa, (62% SMYS)	
External Coating	Dual Layer FBE	HDD sections include Abrasion Resistant Overcoat
Pressure Design Factor	0.72	
Minimum Depth of Cover	1200 mm	

DESCRIPTION	VALUE	COMMENT
Rupture – 4.7 kW/m^2 contour[3]	650 m	Measurement length, calculated at design pressure
Rupture – 12.6 kW/m^2 contour	397 m	Calculated at design pressure
1 GJ/s release	38 mm equivalent diameter hole	Calculated at design pressure
	66 m – 4.7 kW/m^2 contour	
	40 m– 12.6 kW/m^2 contour	
10 GJ/s release	120 mm equivalent diameter hole	Calculated at design pressure
	210 m – 4.7 kW/m^2 contour	
	125 m – 12.6 kW/m^2 contour	
Critical Defect Length	152 mm	Design Pressure
	176 mm	MAOP

Note: Radiation contours and energy release distances have been calculated at the design pressure of 16.55MPag.

2.3 RESISTANCE TO PENETRATION

2.3.1 Excavators

The resistance to penetration calculations are documented in the Penetration Resistance Calculations (GAS-556-CA-ME-002). The calculations are for excavators fitted with various teeth.

Based on typical tooth dimensions presented in AS/NZS 2885.1 Table E5, for 13.5 mm WT pipe:

1) Under normal operating conditions (B = 0.75), the pipe cannot be penetrated by any tooth fitted to a 55 t excavator.
2) Under aggressive operating conditions (B = 1.3), the pipe can be penetrated by a single tiger tooth fitted to a 55 t excavator.

Based on these calculations it is concluded that light excavation equipment used in the Port Kembla region (refer Section 4.2.6) cannot penetrate the Port Kembla Pipeline.

[3] AS/NZS 2885.6 Appendix B1 – "A thermal radiation level of 4.7 kW/m^2 will cause injury, at least second degree burns, after 30 seconds exposure. A thermal radiation level of 12.6 kW/m^2 represents the threshold of fatality, for normally clothed people, resulting in third degree burns after 30 seconds exposure."

2.3.2 Pendulum Augers

Experiments carried out on the SEA Gas Pipeline[4] (DN450, 10.1 mm and 12. mm WT, X70 pipe, MAOP = 15.3 MPag) demonstrated that a 900 mm diameter pendulum auger fitted to a 14 tonne excavator inflicted "minimal damage to the pipeline and did not cause a defect that could result in a leak or rupture of the standard wall pipe under MAOP." Based on this it is concluded that similar equipment cannot penetrate the Port Kembla Pipeline.

2.3.3 Horizontal Directional Drills (HDD)

Experiments carried out by the Energy Pipelines Cooperative Research Centre (EPCRC)[5] provide an indication of the damage caused by light HDD equipment. The experiments were carried out using an experimental rig set-up in a laboratory in the University of Wollongong. The testing was performed using a DN500 (20"), 12.2 mm WT pipe and DN150 (6"), 5.5 mm WT pipe. The laboratory rig was fitted with HDD bits typically used for softer drilling conditions. The report concluded:

> *"In all the experiments, only superficial damage was observed on the 20" and 6" pipe specimens. However, the experimental findings in this project should not be interpreted to imply that HDD equipment cannot inflict more severe damage on pipelines. The reported research only relates to small, portable HDD equipment typically used for utility installation[6]. The experiments were carried out using the smallest HDD drill bits that are actually used in the field and the design specifications of the hydraulic power pack are similar to the smallest HDD machine. This could partly explain the limited extent of damage observed.*

Notwithstanding these qualifications, it is concluded that light HDD equipment used in the Port Kembla region (refer Section 4.2.6) cannot penetrate the Port Kembla Pipeline.

The SMS also considers major HDD projects that may utilise equipment that could significantly damage the pipeline, but concludes that such projects require consultation with Jemena so that the project planning and borehole design will include sufficient separation from the pipeline so that it will not be contacted. These type of projects are carried out by large, well-resourced organisations using specialist contractors, and require detailed planning and high level approvals processes (refer Section 4.2.6).

2.4 DEPTH OF COVER

Where the pipeline is installed using open cut trenching techniques, the minimum depth of cover is 1,200 mm. This depth exceeds the depth of typical excavation activities that are anticipated along pipeline route (e.g. minor utility installation and maintenance). Where the pipeline crosses other utilities in the open cut trench, it will be installed below the utility in accordance with GAS-950-DW-UX-001.

Where the pipeline is installed using HDD, the depth of cover increases from 1,200 mm at the tie in point and typically exceeds 10 m for the majority of the HDD profile. Indicative HDD bore profiles are shown on the alignment sheets.

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[4] Refer to Jarosz, M. and Brierley, L, "Understanding Pipeline Failure in Areas Subject to Land Use Change", presentation to APGA Convention & Exhibition in Adelaide, Oct 2019.
[5] EPCRC Project RP6.3-07 "Final Report – Understanding damage to pipelines due to drilling equipment", Rev 0, April 2019.
[6] Emphasised for the purpose of this report.

2.5 CONSEQUENCE OF GAS RELEASE

2.5.1 Objective

The objective of an AS/NZS 2885 SMS is to assess and mitigate threats that may lead to pipeline failure and thereby prevent harm to people, disruption of supply to the community, and damage to the environment.

2.5.2 Safety

The most likely source of harm to people is an ignited gas release, through either a hole or a rupture. Notwithstanding the energy radiation contour data presented above, it is very difficult to predict the consequence of an ignited gas release in any given scenario. The incident rate on gas transmission pipelines in Australia is very low compared to North America and Europe, and to date there have been no fatalities as the result of a gas release from a high pressure gas transmission pipeline in Australia. Published data from Europe (1970 – 2013)[7] and the United States (1986 – 2015)[8] provides some guidance on the safety consequences of gas releases from high pressure gas transmission pipelines[9].

The combined data (Europe and US) represents ~18 million km-years of data, for which 3,724 gas release incidents from all causes are recorded. Of these, 44 release incidents have resulted in fatalities. Of the 44 fatality incidents, three have resulted in "Catastrophic" consequences (as defined by the AS/NZS 2885.6 risk matrix), being: Carlsbad, New Mexico, United States (2000), 12 fatalities; San Bruno, California, United States (2010), eight fatalities; and Ghislenghien, Belgium (2004) 24 fatalities. These three reported catastrophic (multiple fatality) incidents were associated with a rupture event. In the US the vast majority of incidents are single fatality incidents with two being double fatality incidents. While the data from Europe is less clear, it can be inferred from the EGIG report that a similar trend applies.

Based on the above data, it is concluded that the most severe consequence of an ignited gas release from a hole is most likely one or two fatalities. The most severe consequence of an ignited gas release from a rupture is a multiple fatality event. The data also shows that an ignited gas release from either a hole or a rupture does not necessarily result in a fatality event. While the data presented is for releases for all causes and does not provide information regarding the location of the release, or the presence of people or ignition sources, given that the most significant contributor to gas release incidents is external interference, this conclusion is still valid (i.e. a gas release caused by external interference damage does not necessarily result in a fatality event).

AS/NZS 2885 requires that the pipeline is designed to prevent a rupture (and therefore multiple fatality events), and to limit the energy release rate (to minimise potential safety impacts) in *high consequence areas*[10].

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[7] 9th Report of the European Gas Pipeline Incident Data Group on Gas Pipeline Incidents for the period 1970 – 2013 (https://www.egig.eu/reports)
[8] US Department of Transport (DOT) Pipelines and Hazardous Materials Safety Administration (PHSMA) website http://www.phmsa.dot.gov/
[9] Refer to "Frequency Estimating Guidelines" presented at the APGA AS 2885 Changes Seminar, Sydney, 19 July 2017.
[10] Refer Clause 4.9, AS/NZS 2885.1. See also discussion in Section 4.4 below.

2.5.3 Supply

The consequence of a supply disruption is largely dependent on the location of the damage to the pipeline, and also the degree of interconnection to other sources of supply to the customers affected by the supply interruption.

AS(/NZS) 2885 is primarily concerned with public disruption caused by loss of supply. This particularly applies to public infrastructure that is dependent on gas for energy supply, (e.g. hospitals, or potentially gas-fired power stations which supply public infrastructure). Supply interruptions to industrial customers that result in commercial loss but do not result in societal impacts do not fall under the remit of the AS(NZS) 2885 SMS process.

In time, the Port Kembla Pipeline will supply significant proportions of both the Sydney and Melbourne markets. While both markets currently have alternative sources of supply, an incident resulting in the requirement to carry out major repairs to the pipeline has the potential to result in significant supply restrictions.

In practice, based on the discussion in Section 2.3, the Port Kembla Pipeline cannot be penetrated by the identified credible external interference threats. If the pipeline is contacted and damaged, (or if significant corrosion is identified), under Jemena procedures the immediate action is to reduce the operating pressure to 80% of the pressure at the time of the incident. This maintains supply, albeit at a reduced rate, while damage is assessed and repairs are made. In the worst case, a planned cut out and replacement would be required, but this would be managed to minimise supply impacts.

2.5.4 Environment

In the worst case, a gas release event will result in energy release of the entire contents of the pipeline to atmosphere (i.e. a greenhouse gas emission). This short term impact is insignificant in comparison with any impacts of combustion of the gas (i.e. carbon dioxide released as a product of combustion by end-users) over the life of the pipeline. No other environmental impacts are anticipated.

3 WORKSHOP METHOD

3.1 BRIEF AND AGENDA

The proposed workshop agenda is included in the Workshop Briefing Document (GPA Engineering, Doc No. 20617-REP-015, "Detailed Design SMS Workshop Brief – Port Kembla Pipeline", Rev A, 29-Sept-2021). The workshop discussion is documented by this report.

3.2 ATTENDANCE

The personnel who attended the workshop are listed in Table 2.

Table 2 – Workshop Attendance

Name	Position In Company	Company
Alexandra Lovell	HSE Manager	AIE
Andrew Ginns	Land Liaison Officer	Jemena
Andrew Petch	Pipeline Engineer	AIE
Cameron Moore	Project Manager, Facilities	Jemena
Chris Happe	Project Engineer	AIE
Dario Stella	Senior Pipeline Engineer, Asset Management	Jemena
Frank Losty	Acting Project Manager AIE	Worley
Gavin Sheriff	Land Access	Jemena
James Jimenez	Safety Advisor	AIE
Joel Feeney	GIS Coordinator	Landpartners
John Puljak	Operations EGP, North Side	Zinfra
Karthi Pandiyan	Jemena Assets	Jemena
Max Imsungnoen	Project Engineer, Major Projects	Jemena
Michael Peoples	Engineering Manager, Gas Projects	Jemena
Mick Arneill	Gas Transmission Field Manager, South	Zinfra
Nathan Biggins	Project Manager, Major Projects	Jemena
Neil Dunford	GIS Records Team Leader, Asset Management	Jemena
Nikhil Maharaj	Pipeline Safety Regulator (NSW)	Planning NSW
Peter Wheelright	Construction Manager	Zinfra
Raj Jeyarajah	Principal Pipeline Engineer, Asset Management	Jemena
Rasool Mayahi	Lead Mechanical Engineer	GPA
Renee McCall	Lands Manager, Gas and Electricity Assets	Jemena
Richard McDonough	Principal Risk Engineer	GPA
Sohan Fernando	Senior Safety Analyst, Major Hazard Facilities	SafeWork NSW
Steven Bonnici	Field Manager, EGP	Zinfra
Tory Grillow	Dangerous Goods Team	SafeWork NSW
Warren Woodhouse	Technical Regulator, Licensed Pipelines	Planning NSW
Zac Hill	Mechanical Engineer	GPA

3.3 CONSOLIDATED ACTIONS REPORT

The consolidated actions report is included as Appendix 5.

4 DISCUSSION

4.1 LAND USE AND LOCATION CLASSIFICATION

The general land use is a combination of industrial, commercial and residential land. The pipeline also traverses sections of recreational land within these general locations.

The location classification for the pipeline was assigned by the Jemena project team (based on the FEED SMS review) and recorded on the alignment sheets. The workshop reviewed the route via GIS and confirmed that the primary location class is *Residential (T1)*.

The entire PKP Segment 1 has been allocated a secondary location class of *Heavy Industrial (HI)*. Majority of PKP Segment 2 has been allocated a secondary location class of *Industrial (I)* with some locations allocated a combined secondary location class of *Heavy Industrial / Common Infrastructure Corridor (HI / CIC)*.

The FEED SMS documented that the parcel of land that is loosely bounded by the Princes Motorway, Hopman Crescent, Nolan Street and Nottingham Street will be developed as a "holistic health care precinct" which will include a hospital, palliative care facilities and an aged care centre. The secondary location classification of *Sensitive Use (S)* was applied to this section of the pipeline (KP 8.9 to KP 10.1). Additionally, the Coniston Public School was identified as being within the measurement length of the pipeline. A secondary location classification of *Sensitive (S)* was applied for this location between KP2.4 and KP3.2. As a consequence, the design requirements for *High Density (T2)* apply to this section. This was confirmed at the Detailed Design SMS.

A combined secondary location class of *Heavy Industrial / Common Infrastructure Corridor (HI/CIC)* has been allocated between the start of Segment 2 (KP 6.2) and Lathe Place (KP 7.3) where the pipeline will be installed adjacent to a large number of above ground power lines, and also for the section where the new pipeline will be in a common easement with the existing Port Kembla Lateral Pipeline (KP 8 to KP 8.55 and KP 9.7 to KP 11.8).

The entire route of the pipeline is *high consequence area*[11], to which the provisions for high consequence areas apply[12].

The workshop record of the location classification assessment and a more detailed description of the land use in each section of pipeline is included in Appendix 3.

4.2 OVERVIEW OF TYPICAL THREATS AND CONTROLS

Typical threats and controls under the following categories[13] are documented in Appendix 3. Noteworthy items are discussed below:

4.2.1 Corrosion

The workshop did not identify any particularly unusual corrosion threats.

[11] Refer Clause 1.5.24, AS 2885.0.
[12] Refer Clause 4.9, AS/NZS 2885.1. See also discussion in Section 4.4 below.
[13] Refer Appendix C6, AS/NZS 2885.6.

Coating systems will comply with existing Jemena specifications. This includes additional coating protection (Abrasion Resistant Overcoat system) for sections installed by HDD. Cathodic protection systems have been designed and will be maintained to relevant Australian Standards. The pipeline will be configured so that it can be subject to ILI. Ongoing monitoring and maintenance will be as per the existing Jemena Pipeline Management System.

Provided that the corrosion protection system is designed, applied, installed, monitored and maintained in accordance with the requirements set out in the Design Basis and the existing Jemena Pipeline Management System, corrosion threats will be controlled.

4.2.2 Natural events

No significant threats associated with natural events have been identified. Where the pipeline crosses major waterways, the pipeline is installed by HDD so that depth of cover protects the pipeline from erosion or scour threats. The pipeline does not traverse areas subject to geotechnical instability. Above-ground facilities are located in cleared areas that are not subject to high heat radiation associated with bushfires.

Natural events that present a threat to the pipeline will be controlled by Jemena standard design, operations and maintenance procedures.

4.2.3 Faults in design, materials and construction

Jemena has established design and construction quality processes governed by the project execution plan (document no: GAS-599-PA-QA-001).

Key components of the QMP include:

Design:

- The Design Basis Manual (DBM) is written by an experienced senior engineer. The DBM is subject to Jemena's QA and approval process.
- All calculations, drawings, design reports, engineering assessments, plans and procedures are subject to Jemena's QA and approval process.
- The design is subject to risk assessments, review workshops, HAZOP, SMS, SIL studies as required.
- Design review is completed at key milestones throughout the design process.
- A formal design change process including documenting the design change, review by Jemena Project Engineer (and other Jemena personnel as nominated by the Project Manager) and written approval.

Materials:

- Construction Contractor will develop Materials Management Plan for Jemena approval.
- All materials will be subject to a receiving inspection to verify as a minimum that the items meet description, include the required markings, the required records are received, item is free of damage and thorough inspection of items to ensure compliance.

- The line pipe provider will operate a pipe tracking system ensuring full traceability of every pipe length to its particular heat number, slab, coil and all stages of the manufacturing process. A bar-code system will be used to track the final location of each pipe and incorporate this data to the Jemena GIS system.
- Storage and handling procedure will be in accordance with Jemena document GAS-499-PR-QA-001.

Construction:

- Construction will be managed according to a Construction Management Plan (CMP).
- Jemena Construction Superintendents, Inspection Personnel and other site representatives provide guidance and oversight to Construction personnel.
- Hold and Witness points will be agreed between the Construction Contractor and Jemena.
- Inspection processes are outlined in the QMP including Third Party Inspection at source of purchased products.
- Inspection and testing plans.
- As-built hydrotesting to AS/NZZS 2885.5 prior to commissioning.

4.2.4 Threats related to operational, maintenance and management systems

The operation and maintenance of the Port Kembla Pipeline will be incorporated into the existing EGP Safety Management Manual and the Safety Case (SAOP) for Jemena Gas Assets (NSW) (GAS-999-PA-HSE-002), (Appendix C addresses pipeline integrity management) and associated policies, procedures and work instructions. These documents have been developed to meet the requirements of *AS 2885.3-2012 Pipelines - Gas and liquid petroleum - Operations and Maintenance*.

4.2.5 Intentional damage

No unusual threats relating to intentional damage were identified. Any such threats controlled by the implementation of Jemena's existing security management procedures. Site specific security assessments have been completed for the new above-ground facilities.

4.2.6 External interference

The route of the Port Kembla Pipeline is primarily located in a developed urban / industrial area. The external interference threat profile in these locations is dictated by the following factors:

1) The external interference threats are generally limited to small, light equipment that can be mobilised to, and operated in, that environment. Where excavators are used, they are typically up to 10-12 tonnes. It is rare for larger equipment to be used.
2) The workshop was advised that soil conditions to a depth of 4-6 metres are relatively soft. Below this depth hard rock is encountered. Mud buckets are generally used for excavation. There is no requirement to use tiger teeth or penetration teeth in such conditions. Similarly, vertical boring equipment required to install signage, fence posts and power poles is relatively light. Where HDD is used to install minor utilities, light equipment with bits suitable for soft drilling are used. Minor utilities are typically installed to a depth up to ~600 mm (i.e. ~600 mm above the top of the pipeline).

3) There are two sections of pipeline in Segment 1 that will be installed underneath water crossings; the Gurungaty Waterway Crossing and Allans Creek Crossing. It is noted that any other third party HDD construction under these water crossings is considered a major project (i.e. a planned activity with service location and bore-alignment design, with installation expected to be parallel to the Port Kembla Pipeline, refer also Section 2.3.3 and summary at the end of this section).

4) Where the pipeline will be installed in open-cut trenches in parkland (or similar) areas, these are typically under the care control of the council, and subject to care and maintenance activities only (i.e. not deep excavation or boring with heavy equipment and aggressive teeth / bits).

5) Where the pipeline will be installed in open cut trenches under road pavement or in road verges (primarily within Port Kembla Coal Terminal) any works involving excavation would require planning and approval by the Port authority and equipment is likely light excavation equipment (e.g. for buried utility maintenance) or road maintenance only.

6) In the trenched section between Waynote Place and Lathe Place (KP 7.156 to KP 7.648) it is co-located in the existing Port Kembla Pipeline easement, and runs parallel to a number of overhead powerlines. It is also crossed by HV transmission lines. Consequently, excavation activities in this section need to be carefully planned and are subject multiple approvals requirements by the utility owners.

7) Two land parcels immediately west of Waynote Place are currently being developed (~KP 7.1 to ~KP 7.2). Jemena was consulted in planning of these developments, so that the construction footprint does not impinge on the pipeline easement. Construction of these developments will be completed prior to the installation of the Port Kembla Pipeline.

8) The HDD section that crosses Five Islands Road and Waynote Place (KP 6.812 to ~KP 7.15) traverses two properties currently under development. It was noted that this development did involve rock breaking activities using a 50 tonne excavator. Notwithstanding that these developments will be completed prior to the installation of the Port Kembla Pipeline, the pipeline is located at sufficient depth (~15 metres below ground level) to control any future threats on this site.

9) Where the pipeline is installed by HDD at depths exceeding 10m, it is: a) generally traversing developed land not subject to further development; b) located in hard rock below 4-6 metres; and, c) far deeper than any credible excavation or boring activities that may occur without detailed planning or service locating. In summary, and with reference to the discussion in Section 2.3, the credible external interference threats described above are not capable of penetrating the pipeline.

The following points were also noted:

1) Wollongong Council has long-term plans in place to extend Northcliffe Drive via a bridge across the Princes Highway and the Illawarra Railway at ~KP 10.578. Wollongong Council has consulted with Jemena on the proposal, and will consult further during the design and construction phases. The bridge will be designed so that that span will clear the pipeline easement. No particular additional pipeline protection is required at this location at this time.

2) Jemena is aware of one major project proposed by AIP to install a high voltage power cable that will include an HDD which will potentially encroach on the PKP alignment at ~KP9.8. This and other such projects are carried out by large, well-resourced organisations using specialist contractors, and require detailed planning and high level approvals processes. These processes require consultation with Jemena so that the project planning and borehole design will include sufficient separation from the pipeline. Such major projects are managed on a case-by-case basis as they arise, and no additional specific physical and/or procedural controls are proposed.

4.3 THREATS REQUIRING RISK ASSESSMENT / CONTROL FAILURE CHECK

The Detailed Design SMS did not identify any threats that require risk assessment. In this case, AS/NZS 2885.6 recommends that a "control failure check" is undertaken[14]. However, the Standard notes that "For some pipeline systems that have a low level of threats and/or a high level of protection, it may be difficult or impossible to identify a plausible situation where failure of threat control measures leads to loss of containment or serious consequences. The attempt to identify a worst case failure should be documented."

The Detailed Design SMS did not identify a worst case failure scenario. However, it is noted that the 2020 EGP Operational SMS (GAS-599-RP-RM-014), which covers the existing Port Kembla Lateral Pipeline, addresses the requirements to carry out a risk assessment for "failure threats", which also serve the purpose of a "control failure check". Given that the new proposed Port Kembla Pipeline will fall under the operations and maintenance system for the EGP (including the existing Port Kembla Lateral Pipeline), the controls that will be applied to the Port Kembla Pipeline have been assessed via the EGP SMS. It is noted that the risk profile for the new Port Kembla Pipeline is lower than that for the existing Port Kembla Lateral Pipeline on the basis that: a) the Port Kembla Pipeline has increased wall thickness and therefore resistance to penetration from external interference threats; and, b) substantial sections of the pipeline are installed by HDD at significant depth (typically >10 m), which is well below the credible threats.

4.4 SPECIAL PROVISIONS FOR HIGH CONSEQUENCE AREAS

Clause 5.5.1 of AS/NZS 2885.6-2018 requires that pipelines in *high consequence areas* be assessed for conformance with the requirements of AS/NZS 2885.1 for "no rupture" and maximum energy release rate.

4.4.1 No rupture

AS/NZS 2885.1 Clause 4.9.2 requires that in Residential (T1), High Density (T2), Industrial (I), and Sensitive (S) location classes, (and in Heavy Industrial (HI) and Crowd (C) where relevant), the pipeline shall meet the requirements for "No Rupture". This can be achieved by either:

(a) The hoop stress shall not exceed 30% of SMYS

(b) Critical Defect Length is >150% of the maximum credible defect for the identified threats.

Where neither of these criteria can be met, a formal ALARP assessment is required (refer AS/NZS 2885.6 clause 5.5.1).

[14] Refer Clause 3.7, AS/NZS 2885.6.

For the Port Kembla Pipeline Project, the hoop stress is 62% of SMYS at the design pressure (16.55 MPag) and 56% of SMYS at MAOP (14.895 MPag). Therefore, the hoop stress criterion for "No Rupture" is not met.

However, as discussed in Section 2.5.3, the maximum credible threat cannot penetrate the pipeline, and on this basis the "No Rupture" requirement is met.

4.4.2 Maximum energy release rate

Clause 4.9.3 of AS/NZS 2885.1 requires that, for pipelines carrying flammable gases, the maximum energy release rate shall not exceed 10 GJ/s in Residential (T1) and Industrial (I) locations or 1 GJ/s in High Density (T2) and Sensitive Use (S) locations.

Given that the maximum credible threat cannot penetrate the pipeline, on this basis the maximum energy release requirements are met.

5 SUMMARY

This Detailed Design SMS report has reviewed the two discrete sections of the Port Kembla pipeline:

- Segment 1: From the AIE Onshore Receiving Station at the PKGT to the buried tie-in to Segment 2 at approximately KP6.2.
- Segment 2: From the buried tie-in to Segment 1 to the Kembla Grange Meter Station (KGMS) at approximately KP12. The Segment 2 alignment follows the existing Port Kembla Lateral Pipeline for majority of its route.

The Detailed Design SMS validation workshop for the Port Kembla Pipeline was facilitated by GPA Engineering and conducted via video-conference on 1 October 2021. The workshop considered the alignment as recorded in the Jemena Rev B (Segment 1) and Rev F (Segment 2) alignment sheets and the information and documentation listed in Appendix 1. The SMS Workshop did not identify any unusual threats that cannot be controlled through the current design process. Therefore, no significant impediments to meeting the requirements of AS(/NZS) 2885 were identified.

The primary location classification for the entire pipeline route is *Residential (T1)*, and the secondary location classification is *Heavy Industrial (HI)* for Segment 1 and *Industrial (I)* for Segment 2. For some of the pipeline route a secondary location classification of *Common Infrastructure Corridor (CIC)* is also applied. A *Sensitive Use (S)* location classification applies between approximately KP 8.6 to KP 9.8, to account for the proposal to develop a nearby "holistic health care precinct" which will include a hospital, palliative care facilities and an aged care centre. Additionally, the Coniston Public School was identified as being within the measurement length of the pipeline and a secondary location classification of *Sensitive (S)* was applied for this location between KP2.4 and KP3.2.

The entire route of the pipeline is *high consequence area*[15], to which the provisions for *high consequence areas* apply[16]. This report has determined that the provisions for *high consequence areas* (i.e. "no rupture" and maximum energy release rate) are achieved by virtue of the fact that no credible external interference threats were identified that could penetrate the pipeline.

The detailed workshop record and database report is included in Appendix 3.

A consolidated list of actions in included as Appendix 5. Confirmation that relevant actions are closed out prior to construction and commissioning shall be documented by the pre-construction and pre-commissioning SMS reviews in accordance with the requirements of AS/NZS 2885.6.

[15] Refer Clause 1.5.24, AS 2885.0.
[16] Refer Clause 4.9, AS/NZS 2885.1. See also discussion in Section 4.4 below.

APPENDIX 1 REFERENCES

APPENDIX 1A PROJECT SPECIFIC REFERENCES

References

Ref No.	Document Number	Revision	Title	Originator/Author
1	GAS-599-RP-RM-014	0	Five Yearly SMS - Eastern Gas Pipeline	Jemena
2	GAS-599-PH-RM-001	1	EGP Risk Assessment of Common Threats to Standard Designs	Jemena
3	GAS-599-RP-IN-012	1	EGP Integrity Report - External Interference and Pipeline Route	Jemena
4	GAS-599-RP-IN-011	1	EGP Integrity Report - Corrosion	Jemena
6	EGP SMSM 2020.2		FILE NOTE - EGP External Interference Threats - Field Input	Jemena
7	EGP SMS Workshop Technical Information(2).pptx		AS2885.1 SMS Workshop, Technical Information, October 2016	Jemena
8	EGP_Location_Class_2020.slsx		Updated Location Classes August 2020	Jemena
9	EGP SMSM 2020.1		FILE NOTE - 2020 Location Class Review	Jemena
11	Peat Fire SMS-Rev 0.xlsx		Peat Fire SMS	Jemena
15	GAS-599- PA-LM-001 / 002		EGP Landholder Engagement Plan (001-NSW, 002 Victoria)	Jemena
16	GAS-599-PA-IN-002		EGP Pipeline Integrity Management Plan	Jemena
17	GTS-599-RP-EV-009		EGP Facility Bushfire Study	Jemena
18	GAS-960-GL-PL-001	8	Guideline to designing constructing and operating around existing AS2885 natural gas pipelines	Jemena
19	GAS-599-RP-RM-001	0	EGP Security Assessment	Jemena
20	GAS-599-RP-RM-013	1	EGP Expansion Security Assessment	Jemena
23	GAS-556-DG-DN-001	E	Port Kembla Pipeline Design Basis Manual	GPA Engineering
24	GAS-556-CA-ME-002	1	Resistance to Penetration Calculation	GPA Engineering
25	GAS-556-CA-ME-001	1	Critical Defect Length Calculation	GPA Engineering
26	GAS-556-CA-PL-006	2	Road Crossing Calculation	GPA Engineering
27	GAS-556-CA-PL-008	1	Rail Crossing Calculation	GPA Engineering
28	411010-00071-PL-REF-0003	1	Port Kembla Lateral Looping HDD Report (Pre-FEED Phase)	Worley/COE Drilling
29	GAS-599-DG-DN-001	E	Project Marlin: EGP Reversal Facilities Design Basis Manual	GPA Engineering
30	GAS-556-CA-PL-003	1	Pipe Wall Thickness Calculation	GPA Engineering
31	GAS-556-CA-PL-004	1	Radiation Contours Calculation	GPA Engineering
32	GAS-556-CA-PL-005	1	Induction Bend Calculation	GPA Engineering
33	GAS-556-SP-PL-002	0	External Coating Specification	GPA Engineering
34	GAS-556-SP-PL-001	F	Line Pipe Specification	GPA Engineering
35	GAS-556-SP-PL-004	0	Internal Coating Specification	GPA Engineering
36	GAS-556-SP-PL-005	0	Field Joint Coating Specification	GPA Engineering
37	GAS-556-SP-PL-007	C	Project Marlin Pipeline Construction Specification	GPA Engineering

Ref No.	Document Number	Revision	Title	Originator/Author
38	GAS-556-RP-ME-004	B	Fracture Control Plan	GPA Engineering
39	GAS-556-RP-GI-001	0	PKP Pipeline Geotechnical and Contamination Site Investigation Report (Segment 2)	Golder
40	GAS-950-DW-PL-001	0	PKLL Pipeline Trench Bedding and Padding Typical Drawing	GPA Engineering
41	GAS-950-DW-PL-007	1	PKLL Pipeline Trench Breakers Typical Drawing	GPA Engineering
42	GAS-950-DW-CC-001	0	PKLL Pipeline Mechanical Protection Slab and Installation Typical Drawing	GPA Engineering
43	GAS-950-DW-UX-001	0	PKLL Pipeline Buried Utility Crossing Open Cut Type Typical Drawing	GPA Engineering
44	GAS-950-DW-HX-003	0	PKLL Pipeline Bored Road Crossing (Uncased) Typical Drawing	GPA Engineering
45	GAS-950-DW-HX-001	0	PKLL Pipeline Open Cut Road/Track Crossing Typical Drawing	GPA Engineering
46	GAS-950-DW-PL-008	0	PKLL Pipeline Pipeline Marker Post and Installation Typical Drawing	GPA Engineering
47	950-DW-RW-009	1	PKLL Pipeline Pipeline Marker Sign Typical Drawing	GPA Engineering
48	GAS-950-DW-HX-004	0	PKLL Pipeline Pipeline Parallel to Road Typical Drawing	GPA Engineering
49	GAS-950-DW-UX-004	1	PKLL Pipeline Pipeline Parallel to Power Line Typical Drawing	GPA Engineering
50	GAS-950-DW-UX-003	0	PKLL Pipeline Transmission Power Line Crossing Typical Drawing	GPA Engineering
51	GAS-950-DW-UX-002	0	PKLL Pipeline HV Power Line - Safe Distances and Clearances Typical Drawing	GPA Engineering
52	GAS-950-DW-RW-013	0	PKLL Pipeline Right of Way 30m Easement Typical Drawing	GPA Engineering
53	GAS-950-DW-RW-016	0	PKLL Pipeline Right of Way 15m Easement Typical Drawing	GPA Engineering
54	GAS-558-CA-PL-001	0	(Out of Scope) Cringila Lateral Pipeline Nitrogen Release Measurement Length Calculation	GPA Engineering
55	GAS-554-MA-AL-001 to 010	E	Port Kembla Pipeline Segment 1 Alignment Sheets	Jemena
56	GAS-556-MA-AL-001 to 006	E	Port Kembla Pipeline Segment 1 Alignment Sheets	Jemena
57	GAS-558-MA-AL-001	B	(Out of Scope) Cringila Lateral Pipeline Alignment Sheet	Jemena
58	GAS-556-MA-AL-007 to 019	F	Port Kembla Pipeline Segment 2 Alignment Sheets	Jemena
60	GAS-556-DW-UX-001	0	Port Kembla Lateral Crossing Detail (Near Temple Foot Bridge)	GPA Engineering
61	GAS-558-DW-ME-001	B	(Out of Scope) Port Kembla Pipeline Cringila Lateral Tie-In General Arrangement	GPA Engineering
62	GAS-556-RP-CP-002	A	Electrical Hazard Assessment (AS4853) Study	CCE

Ref No.	Document Number	Revision	Title	Originator/Author
63	GAS-556-RP-CP-001	A	Cathodic Protection Design Report	CCE
64	GAS-556-DW-CP-001-01 to GAS-556-DW-CP-001-07	A	CP Design Drawings	CCE
65	401010-01496-MA-REP-1406	A	Port Kembla Gas Terminal Factual Geotechnical Investigation Report - Trenchless Pipeline Crossing	Worley
66	GAS-556-RC-PL-002	0	PKP Hydrogen Conversion Memorandum	GPA Engineering
68	GAS-556-CA-PL-009	0	Pipeline Buoyancy Calculation	GPA Engineering
69	GAS-556-PA-SV-001	1	Port Kembla Pipeline - Pipeline Survey Plan	Jemena
70	GAS-556-RP-PL-001	2	Port Kembla Pipeline - Pipeline Design Report	GPA Engineering
71	AS/NZS 2885.0-2018	2018	Pipelines - Gas and liquid petroleum - General Requirements	
72	AS/NZS 2885.1-2018	2018	Pipelines - Gas and liquid petroleum - Design and construction	
73	AS 2885.3-2012	2012	Pipelines - Gas and liquid petroleum - Operations and Maintenance	
74	AS/NZS 2885.6-2018	2018	Pipelines - Gas and liquid petroleum - Pipeline Safety Management	
75	AS/NZS 4853-2012	2012	electrical hazards on metallic pipelines	
76	AS/NZS ISO 3100-2009	2009	Risk Management, Principles and Guidelines	
77	AS 1345		Identification of the contents of pipes, conduits and ducts	
78	AS 4853-2012		Electrical hazards on metallic pipelines	
79	GTS-960-SP-ME-013	0	Specification for Galvanising	Jemena
80	GTS-960-SP-ME-001		Liquid Coating Specification for Above Ground Steel Assets	Jemena
81	GTS-960-DG-PI-001		Piping Design Guide	Jemena
82	GTS-960-SP-IN-001	0	Gas Facilities Bolting Coating Specificaiton	Jemena
83	GTS-960-SP-ME-009	0	Specification for insulation of Piping and Equipment	Jemena
84	GAS-999-SP-PL-002		Specification for pipe air/ground transition inspection	Jemena
85	AS/NZS 3000-2018		Electrical installations	
86	AS 2832.1		Metallic Pipes Cathodic Protection	
87	GAS-599-PA-QA-001	0	Marlin Project Quality Management Plan	Jemena
88	GAS-499-PR-QA-001		Equipment Shipping and Handling Procedure	Jemena
90	AS/NZS 1170.4		Structural design actions - Earthquake actions	
91	411010-00484-SR-REP-0001	0	Port Kembla Gas Terminal to Eastern Gas Pipeline - Final Hazard Analysis	Worley
92	GAS-557-RP-RM-001	1	EGP Kembla Grange Main Line Valve Security Risk Assessment (Incorporating Project Marlin Upgrade)	Jemena

Ref No.	Document Number	Revision	Title	Originator/Author
93	PKGT-AIE-FEED-0155	0	Observation and Simulation of Infragravity and Far-Infragravity Waves	AIE

APPENDIX 1B LIST OF STANDARDS AND OTHER REFERENCES

REFERENCE	DOCUMENT TITLE
AS 1345	Identification of the contents of pipes, conduits and ducts
AS 2832.1-2015	Cathodic protection of metals Pipe and Cables
AS/NZS 2885.0-2018	Pipelines – Gas and liquid petroleum – General Requirements
AS/NZS 2885.1-2018	Pipelines – Gas and liquid petroleum – Design and construction
AS 2885.3-2012	Pipelines – Gas and liquid petroleum – Operations and Maintenance
AS/NZS 2885.6-2018	Pipelines – Gas and liquid petroleum – Pipeline Safety Management
AS/NZS 3000-2018	Electrical installations
AS/NZS ISO 3100-2009	Risk Management, Principles and Guidelines
AS/NZS 4853-2012	Electrical hazards on metallic pipelines

APPENDIX 1C LIST OF ACRONYMNS

ABBREVIATION	DESCRIPTION
AIE	Australian Industrial Energy
AIP	Australian Industrial Power
ALARP	As Low As Reasonably Practicable
AS	Australian Standard
CDL	Critical Defect Length
DBM	Design Basis Manual
DBYD	Dial Before You Dig
DN	Nominal Diameter
DOC	Depth of Cover
EGP	Eastern Gas Pipeline
EIP	External Interference Protection
EPCRC	Energy Pipeline Cooperative Research Centre
FBE	Fusion Bonded Epoxy
FEED	Front End Engineering Design
FJC	Field Joint Coating
FOC	Fibre Optic Cable

ABBREVIATION	DESCRIPTION
FSRU	Floating Storage Regasification Unit
GIS	Geographic Information System
GJ/s	Gigajoules per second (energy release rate)
GP	General Purpose
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HDD	Horizontal Directional Drill
HV	High Voltage
ICCP	Impressed Current Cathodic Protection
KGMS	Kembla Grange Meter Station
KP	Kilometre Point
kW/m^2	Kilowatts per metre squared (heat radiation flux)
LNG	Liquefied Natural Gas
MAOP	Maximum Allowable Operating Pressure
MLA	Marine Loading Arm
MLV	Main Line Valve
MMSCFD	Million Standard Cubic Feet per Day
ORF	Onshore Receiving Facility
PKGT	Port Kembla Gas Terminal
PKP	Port Kembla Pipeline
QA	Quality Assurance
R1	Rural location classification
R2	Rural Residential Use location classification
ROW	Right of Way
RTP	Resistance to Penetration
S	Sensitive Use location classification
SIL	Safety Integrity Level
SMS	Safety Management Study
SMYS	Specified Minimum Yield Strength
SSD	Solid State Decoupler
T1	Residential location classification

ABBREVIATION	DESCRIPTION
T2	High Density location classification
TJ/d	Tera Joules per day
WT	Wall Thickness

APPENDIX 2 WORKSHOP MATERIALS

APPENDIX 2A WORKSHOP BRIEFING

GPA Engineering Pty Ltd
Phone 08 8299 8300
enquiries@gpaeng.com.au
gpaeng.com.au

Detailed Design SMS Workshop Brief

Port Kembla Pipeline

Jemena Ltd

GPA Document No: 20617-REP-024

GPA Project No: 20617

Rev	Date	By	Checked	QA	Description
A	29/09/2021	ZAH	RMcD		Issued for workshop

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

Jemena owns and operates the existing Eastern Gas Pipeline including the existing Port Kembla Lateral Pipeline.

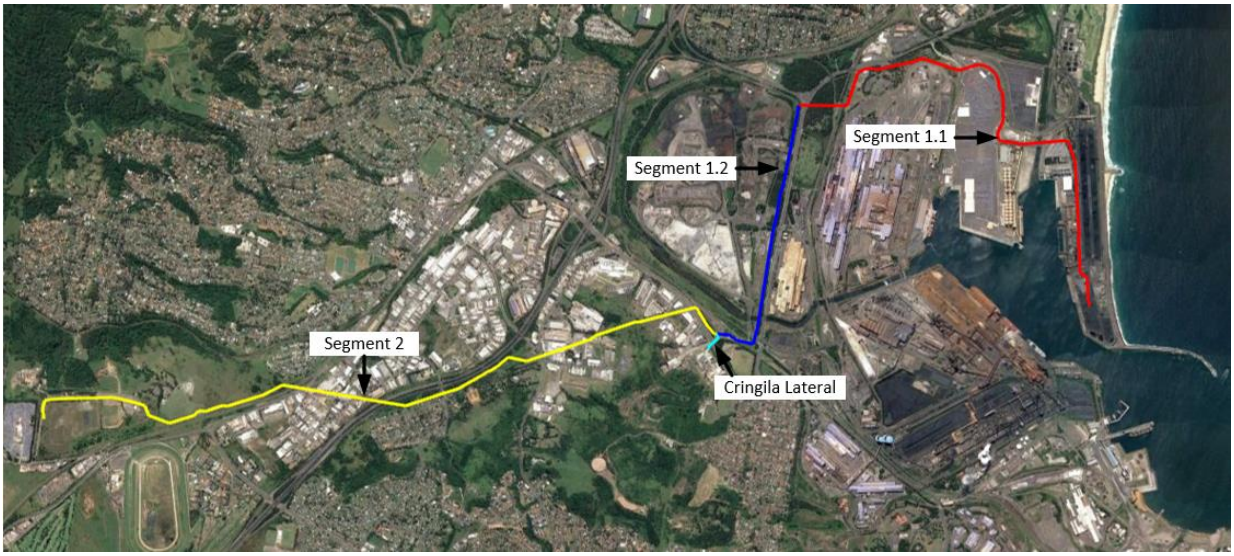
Australian Industrial Energy (AIE) plans to develop New South Wales' first liquefied natural gas (LNG) import terminal at Port Kembla near Wollongong. Once constructed, the Port Kembla Gas Terminal (PKGT) will have the capacity to deliver 500 MMSCFD of gas to the Jemena network.

A new approx. 12 km DN450 pipeline will be constructed between a new onshore receiving facility at PKGT and a new meter station at Kembla Grange (Kembla Grange Meter Station) where it will connect to the EGP near the Kembla Grange mainline valve (MLV) station via hot tap. The PKGT facility will consist of the marine loading arms, odorisation equipment and pipeline pig launcher. The Kembla Grange Meter Station will consist of a pig receiver, custody transfer metering skid, gas quality monitoring and actuated shutdown valve. The new pipeline will be referred to as the Port Kembla Pipeline for the purposes of this Safety Management Study.

The **Port Kembla Pipeline** is divided into two segments as follows:

- Segment 1:
    - Segment 1.1: From the downstream weld on the MIJ at PKGT to the buried weld at the downstream end of the Springhill Rd HDD Crossing (approximately KP4.0)
    - Segment 1.2: From the buried weld at the downstream end of the Springhill Rd HDD crossing (approximately KP4.0 to the downstream weld of the barred tee at the Cringila Lateral Pipeline tie-in (Approximately KP6.2)
- Segment 2: From the buried weld on the downstream side of the barred tee at the Cringila Lateral Pipeline tie-in (Approximately KP6.2) to the upstream weld on the MIJ at the KGMS (approximately KP11.87)

The **Cringila Lateral Pipeline** will be a 0.15 km DN450 pipeline constructed between the Cringila Lateral Inlet Facility located at BOC Plant on Five Islands Rd and a buried tie-in to the PKP at Cringila. The Cringila Lateral will deliver nitrogen for Wobbe Index and Higher Heating Value correction. The Cringila Lateral Inlet Facility includes a tie-in for the BOC supplied metering skid and a blank flange for launching a crawler pig.



The Port Kembla Pipeline will follow the existing Port Kembla Lateral Pipeline for majority of Segment 2. Segment 1 diverges from the existing Port Kembla Lateral at Cringila. The primary location classification is *Residential (T1)* for the entire route, with a mixture of secondary location classification including *Industrial (I), Heavy Industrial (HI)* and *Sensitive Use (S).*

There are eleven (11) HDD sections along the pipeline and two (2) bored road crossings. The rest of the pipeline will be installed by normal trenching practices at a typical depth of 1,200 mm.

The maximum allowable operating pressure for the pipeline is 14.895 MPag in line with the existing EGP. However, the design pressure has been selected at 16.55 MPag to allow for future increases in the operating pressure (as summarised in Jemena's EGP Operations Manual GTS-599-OM-GEN-001).

The governing legislation requires that the Port Kembla Pipeline complies with Australian Standard AS(/NZS) 2885: *Pipelines – Gas and liquid petroleum*. This standard covers the design, construction, operation and maintenance of high pressure gas and liquid petroleum pipelines. It mandates a robust Safety Management Study is maintained for pipelines to manage all potential threats to pipeline integrity.

This SMS is being undertaken in the Detailed Design phase of the project.

1.2 SCOPE AND OBJECTIVE

GPA Engineering has been engaged by Jemena to conduct the Detailed Design for the Port Kembla Pipeline Project.

The Detailed Design Safety Management Study (SMS) validation workshop (refer Section 5.4.4 of AS/NZS 2885.6) will consider the Port Kembla Pipeline, which extends from Port Kembla Gas Terminal to a hot tap at the tie-in to the EGP adjacent Kembla Grange Mainline Valve Station. It will also consider the new PKGT facility, Kembla Grange Metering Station, and above ground facility at Cringila Lateral Inlet Facility at BOC Plant. The PKGT facility will include a pig launcher and odorisation equipment. The Kembla Grange Meter Station will include a pig receiver, custody transfer metering skid and gas quality metering. The Cringila Lateral Inlet Facility will include a tie-in point for the BOC supplied inlet skid as well as a blank flange to accommodate a crawler pig.

The methodology for the SMS shall be in accordance with AS/NZS 2885.6-2018, Part 6 – Pipeline Safety Management.

The workshop shall review Detailed Design data that has been entered into the GPA Guardian SMS database, based on:

- Basic Pipeline Parameters
- Design calculations and drawings
- Design Basis information
- Location classification data documented in the Rev B and Rev F alignments sheets,
- The current route and crossings information documented in the Jemena GIS.
- Threat and control information that has been developed for the 2020 EGP operational SMS workshop (to be conducted 9-13 November 2020) – for Segment 2 only.

The workshop shall be attended by key project, design, operations, maintenance and engineering personnel.

The workshop will take place via video-conference on 1 October 2021.

Representatives of the following stakeholders have been invited to the workshop:

- Jemena
- GPA Engineering
- Zinfra
- AIE
- Planning NSW
- Safework NSW

2 PREVIOUS SAFETY MANAGEMENT STUDIES

The preliminary design SMS is documented in the Doc No: 411010-00071 - SR-REP-0001 – *Port Kembla Lateral Looping NGP2 Pipeline FEED.*

The FEED SMS is documented in the Doc No: GAS-556-RP-RM-001 – *FEED SMS Report.*

3 AS/NZS 2885 SMS METHODOLOGY – GENERAL

The AS(/NZS) 2885 Pipeline Safety Management Study process is shown by the diagram extracted from AS/NZS 2885.6-2018 (refer Appendix 1) and is summarised below:

(a) Location analysis and classification.

(b) Threat identification.

(c) Threat control.

(d) Failure analysis of threats where failure is still possible.

(e) Qualitative risk assessment and treatment of residual risk:

  (i) High or extreme risks are not acceptable.

  (ii) Intermediate risks require a formal ALARP assessment including application of additional

controls as necessary.

(iii) Low or negligible risks are deemed to be ALARP.

Where qualitative risk assessment is required, it will be carried out in accordance with the risk matrices published in AS/NZS 2885.6-2018 (included in Appendix 3).

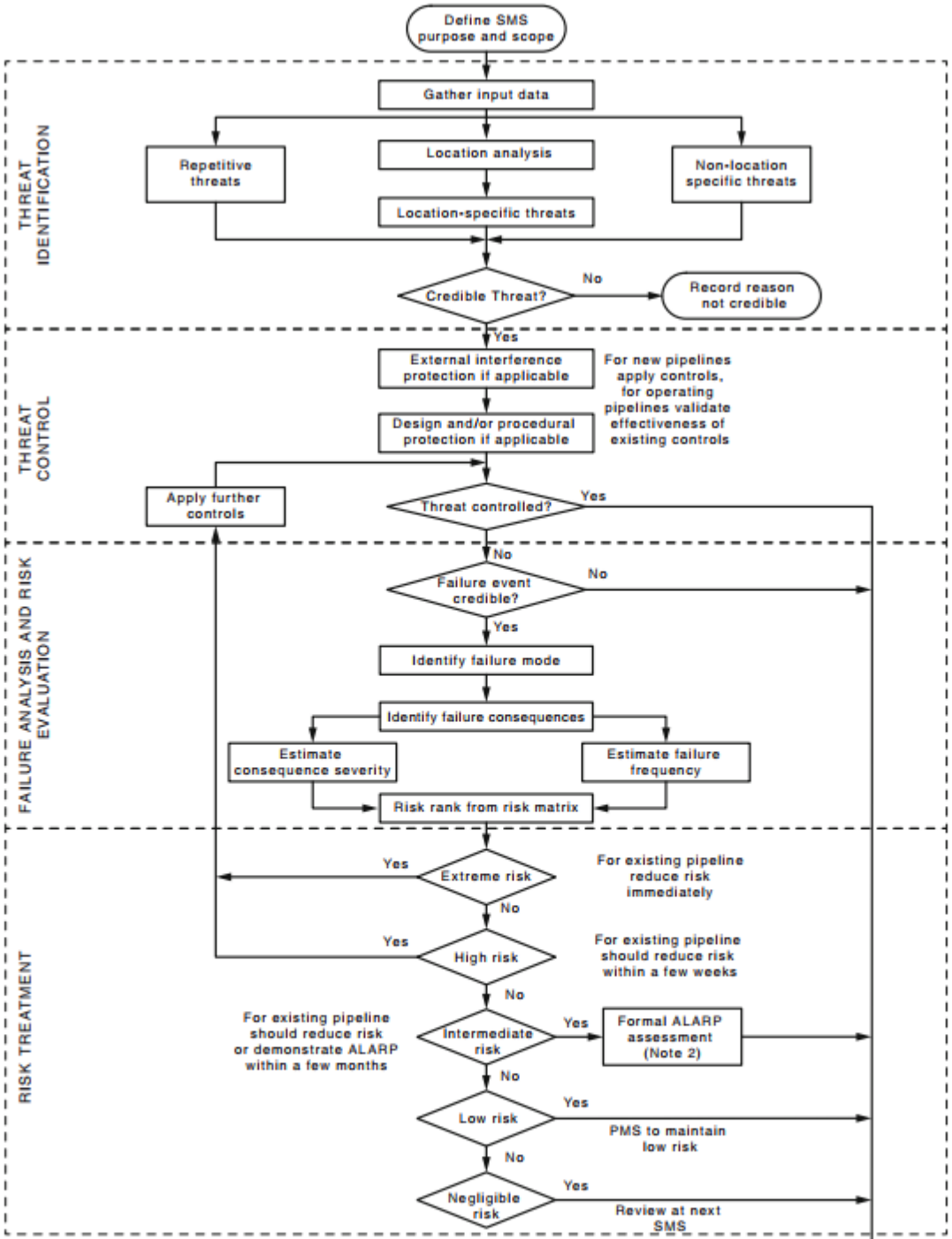
4 PROPOSED AGENDA

The following Agenda is proposed for the workshop. The schedule may vary depending on the detailed discussions and the need to cover any additional topics. The final Agenda will be determined by participants during course of the workshop.

Friday 1st October 2021	
9:00 - 9:20 AET 8:30 – 8:50 ACT	Participants Arrive and Introductions
9:20 – 9:40 AET 8:50 – 9:10 ACT	AS/NZS 2885.6 SMS Overview (GPA)
9:40 – 10:10 AET 9:10 – 9:40 ACT	**Port Kembla Pipeline Overview – design and as-built parameters (Jemena);** • Route / facilities • Pipe material, diameter, wall thickness, MAOP • Pipeline fluid (LNG / N2 / Hydrogen) • Depth of burial • Measurement Length / Location Classification (general) • Critical Defect Length • Resistance to Penetration
10.10 – 10:45 AET 9:40 – 10:15 ACT	**Typical Non-EIP – CORROSION – Buried Pipeline and Facilities** • Current Controls (design and procedures) • Threats Review
10:45 – 11:00 AET 10:15 – 10:30 ACT	**BREAK**
11:00 – 11:30 AET 10:30 – 11.00 ACT	**Typical Non-EIP – NATURAL EVENTS – Buried Pipeline and Facilities** • Current Controls (design and procedures) • Threats Review
11:30 – 11:50 AET 11:00 – 11.20 ACT	**Typical Non-EIP – OPERATIONS / MAINTENANCE / MANAGEMENT SYSTEMS**
11:50– 12:35 AET 11.20 – 12:05 ACT	**Typical Non-EIP – DESIGN, MATERIALS, CONSTRUCTION / INTENTIONAL DAMAGE / OTHER – Buried Pipeline and Facilities** • Current Controls (design and procedures) • Threats Review (include H2 service)
12:35 – 13:30 AET 12:05 – 13:00 ACT	**LUNCH**

Friday 1st October 2021	
13:30 – 15:00 AET 13:00 – 14:30 ACT	**Typical EXTERNAL INTERFERENCE THREATS – Buried Pipeline and Facilities** • Physical and Procedural Controls • Threats Review
15:00 – 15:15 AET 15:30 – 15:45 ACT	**BREAK**
15:15 – 16:15 AET 14:30 – 15:30 ACT	**GIS / ALIGNMENT SHEET ROUTE REVIEW**
16:15 – 17:00 AET 15:45 – 16.30 ACT	**SUMMARY and ACTIONS REVIEW**

APPENDIX 1 AS/NZS 2885.6-2018 SMS PROCESS



NOTES:

1. This flowchart is an informative aid to assist in interpretation of the safety management process. Safety management requirements are fully defined in the text and take precedence over this flowchart.
2. Formal ALARP assessment may require multiple further steps including design, revision to the PMS, risk evaluation, etc, possibly involving various loops through the flowchart which have been omitted for simplicity.

FIGURE A1 SAFETY MANAGEMENT PROCESS FLOWCHART

APPENDIX 2 AS/NZS 2885.6-2018 SMS GUIDEWORDS

Based on AS/NZS 2885.6 Appendix C6:

1. General Review of Pipeline Design
2. External Interference Threats
3. Corrosion
4. Natural Events
5. Threats related to Operational, Maintenance and Management Systems
6. Faults in Design, Materials and Construction
7. Intentional Damage
8. Miscellaneous

APPENDIX 3 AS/NZS 2885.6-2018 SMS RISK MATRIX

Threats requiring risk assessment will be assessed using the Safety Management Study Matrices taken from AS/NZS 2885.6, and Appendix F.

TABLE 3.1

SEVERITY CLASSES

Dimension	Severity class				
	Catastrophic	Major	Severe	Minor	Trivial
	Measures of severity				
People	Multiple fatalities result	One or two fatalities; or several people with life-threatening injuries	Injury or illness requiring hospital treatment	Injuries requiring first aid treatment	Minimal impact on health and safety
Supply (see Note)	Widespread or significant societal impact, such as complete loss of supply to a major city for an extended time (more than a few days)	Widespread societal impact such as loss of supply to a major city for a short time (hours to days) or to a localized area for a longer time	Localized societal impact or short-term supply interruption (hours)	Interruption or restriction of supply but shortfall met from other sources	No loss or restriction of pipeline supply
Environment	Impact widespread; viability of ecosystems or species affected; or permanent major changes	Major impact well outside PIPELINE CORRIDOR or site; or long-term severe effects; or rectification difficult	Localized impact, substantially rectified within a year or so	Impact very localized and very short-term (weeks), minimal rectification	No effect; or minor impact rectified rapidly (days) with negligible residual effect

NOTE: Appendix G provides guidance on assessment of consequence severities.

TABLE F1

FREQUENCY CLASSES

Frequency class	Frequency description	Numerical guidelines (events/1000 km/year)
Frequent	Expected to occur once per year or more	≥1
Occasional	May occur occasionally in the life of the pipeline	1 to 0.1
Unlikely	Unlikely to occur within the life of the pipeline, but possible	0.1 to 0.001 (10^{-1} to 10^{-3})
Remote	Not anticipated for this pipeline at this location	0.001 to 0. 00001 (10^{-3} to 10^{-5})
Hypothetical	Theoretically possible but would only occur under extraordinary circumstances	<0. 00001 ($<10^{-5}$)

TABLE 3.3
RISK MATRIX

	Catastrophic	Major	Severe	Minor	Trivial
Frequent	Extreme	Extreme	High	Intermediate	Low
Occasional	Extreme	High	Intermediate	Low	Low
Unlikely	High	High	Intermediate	Low	Negligible
Remote	High	Intermediate	Low	Negligible	Negligible
Hypothetical	Intermediate	Low	Negligible	Negligible	Negligible

NOTE: Comparative studies sponsored by the Energy Pipelines Cooperative Research Centre have shown that for risks ranked as Intermediate, Table 3.3 produces results consistent with both reliability-based analysis (in accordance with Annex O of CSA Z662-07) and quantitative risk assessment. Use of a different risk matrix or method that has not been similarly calibrated may produce invalid results.

TABLE 3.4
RISK TREATMENT ACTIONS

Risk rank	Required action
Extreme	Modify the THREAT, the frequency or the consequences so that the risk rank is reduced to Intermediate or lower. For an in-service pipeline, the risk shall be reduced immediately.
High	Modify the THREAT, the frequency or the consequences so that the risk rank is reduced to Intermediate or lower. For an in-service pipeline, the risk shall be reduced as soon as possible. Risk reduction should be completed within a timescale of not more than a few weeks.
Intermediate	Repeat THREAT identification and risk evaluation processes to verify the risk estimation; determine the accuracy and uncertainty of the estimation. Where the risk rank is confirmed to be "intermediate", where reasonably practicable modify the THREAT, the frequency or the consequence to reduce the risk rank to "low" or "negligible". Where it is not reasonably practicable to reduce the risk rank to "low" or "negligible", action shall be taken to— (a) remove THREATS, reduce frequencies and/or reduce severity of consequences to the extent practicable; and (b) formally demonstrate ALARP (see Section 4). For an in-service pipeline, the reduction to "low" or "negligible" or demonstration of ALARP shall be completed as soon as possible. Risk reduction or demonstration of ALARP should be completed within a few months.
Low	Determine the management plan for the THREAT to prevent occurrence and to monitor changes that could affect the classification.
Negligible	Review at the next relevant SMS (for periodic operational review, LAND USE CHANGE, ENCROACHMENT, or change of operating conditions).

APPENDIX 3 CRINGILA LATERAL PIPELINE

APPENDIX 3A BACKGROUND

The original project scope as reviewed at the Detailed Design SMS workshop included Segment 1 and Segment 2 the Port Kembla Pipeline, and an additional segment known as the Cringila Lateral (CL) Pipeline; a 0.15km, DN450 pipeline from the Cringila Lateral Inlet Facility at BOC plant adjacent Five Island Road to the PKP pipeline tie-in at Cringila at approximately KP6.2. The Cringila Lateral pipeline was designed to inject nitrogen into the PKP for Wobbe index and higher heating value (HHV) correction.

After the completion of the SMS workshop and issue of Revision 0 of this report, the Jemena project team advised that the CL pipeline would not be installed as part of the project scope. Revision 1 of this report reflects this change. Details of the CL have been retained within this Appendix and the SMS database report for reference only. References to the Cringila Lateral within the SMS database record have been annotated with 'Out of Scope' to maintain a record of the review but to avoid confusion as to the project scope, however, the Actions list has been updated to remove all actions relating to the Cringila Lateral as these no longer require close out; any actions relating to the Cringila Lateral can be found in Revision 0 of this report.

The Cringila Lateral was designed to AS 2885 as a natural gas pipeline, with assessment of the implications of Nitrogen service where relevant.

The Cringila Lateral alignment considered in the detailed design SMS workshop was the alignment as recorded in the Rev B alignment sheets, refer Figure 2 below for an overview of the alignment.

There is one HDD road crossing within the Cringila Lateral Pipeline at Five Islands Rd.

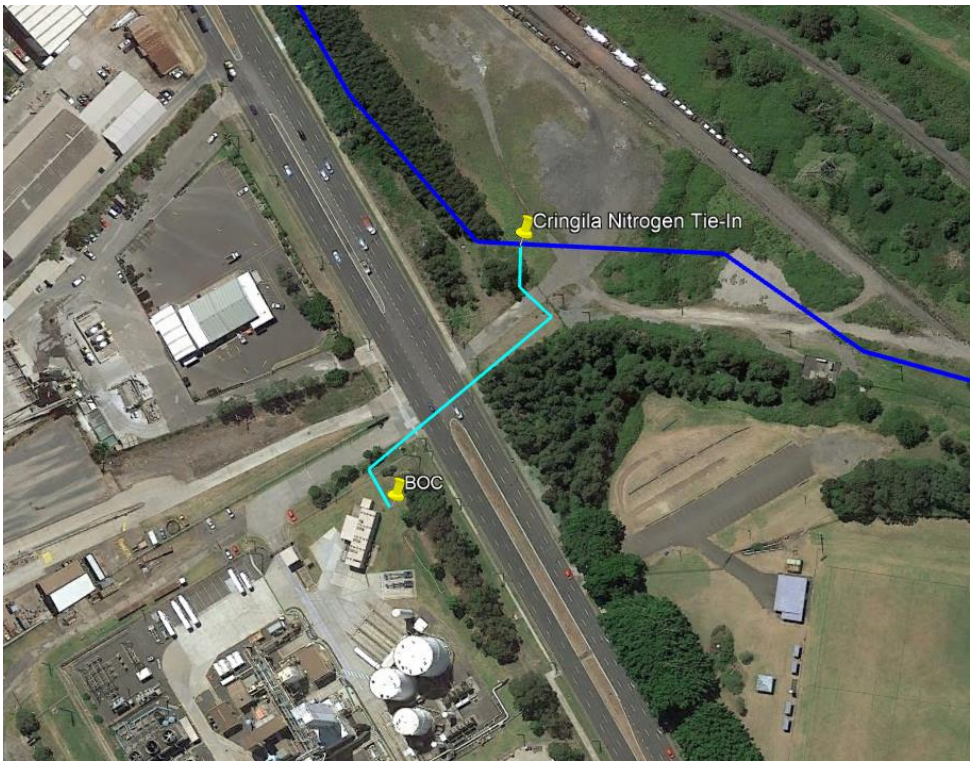


Figure 2 – Cringila Lateral Pipeline Overview

APPENDIX 3B PIPELINE DESIGN PARAMETERS

The design parameters for the Cringila Lateral pipeline are provided in Table 3:

Table 3 – Cringila Lateral Pipeline Design Parameters

DESCRIPTION	VALUE	COMMENT
Nominal Diameter	DN450 (OD 457 mm)	
Length	150m	
MAOP	14,895 kPag	EGP MAOP. Typical delivery pressure to EGP will be ~9,000kPag
Design Pressure	16,550 kPag	Design pressure to allow for future MAOP upgrade of EGP
Wall Thickness (minimum)	13.5 mm	Minimum specified WT. Actual WT will be determined by availability of pipe.
Line Pipe	API 5L Grade X65 SMYS = 450 MPa	
Hoop Stress (design pressure)	280 MPa, (62% SMYS)	
External Coating	Dual Layer FBE	HDD sections include Abrasion Resistant Overcoat
Pressure Design Factor	0.72	
Minimum Depth of Cover	1200 mm	
Rupture – 71,000ppm N2 *(Cringila Lateral Pipeline)*	610 m	Considered for Cringila Lateral Pipeline only. Considers release of pure Nitrogen. Refer Appendix 3C.
Rupture – 4.7 kW/m^2 contour[17]	650 m	Measurement length, calculated at design pressure
Rupture – 12.6 kW/m^2 contour	397 m	Calculated at design pressure
1 GJ/s release	38 mm equivalent diameter hole	Calculated at design pressure
	66 m – 4.7 kW/m^2 contour	
	40 m– 12.6 kW/m^2 contour	
10 GJ/s release	120 mm equivalent diameter hole	Calculated at design pressure
	210 m – 4.7 kW/m^2 contour	
	125 m – 12.6 kW/m^2 contour	

[17] AS/NZS 2885.6 Appendix B1 – "A thermal radiation level of 4.7 kW/m^2 will cause injury, at least second degree burns, after 30 seconds exposure. A thermal radiation level of 12.6 kW/m^2 represents the threshold of fatality, for normally clothed people, resulting in third degree burns after 30 seconds exposure."

DESCRIPTION	VALUE	COMMENT
Critical Defect Length	152 mm	Design Pressure
	176 mm	MAOP

Note: Radiation contours and energy release distances have been calculated at the design pressure of 16.55MPag.

APPENDIX 3C CONSEQUENCE OF GAS RELEASE (NITROGEN)

The consequence of nitrogen release resulting from penetration or full bore rupture of the Cringila Lateral Pipeline is asphyxiation by reduction of the oxygen level in the local atmosphere. Nitrogen is a simple asphyxiant as it is non-toxic and, when present in an atmosphere at high concentrations, leads to a reduction of oxygen concentration by displacement or dilution. The Safe Work Australia document '*Guidance on the Interpretation of Work Place Exposure Standards for Airborne Contaminants'* states that the minimum oxygen content in air should be 19.5% at normal pressure. Assuming a normal oxygen concentration in air of 21%, the minimum corresponds to a dilution of 7.1%, i.e. additional nitrogen concentration of 7.1% or 71,000 ppm.

For the purposes of determining a 'measurement length' for assessment of the consequence of a nitrogen release event for this SMS review, dispersion modelling was completed to calculate the distance from the source of release where the nitrogen concentration remains above 71,000ppm. The method and calculation are documented in calculation report GAS-558-CA-PL-001. The distance from the pipeline for which the nitrogen concentration remains above a level that would cause asphyxiation is provided in Table 4.

Table 4 – Dispersion Modelling Results

	71,000 ppm Plume Distance (m)	
	Horizontal Extent	Vertical Extent
Full-Bore Rupture	610	20
50 mm Leak	220	5

Note that the minimum 'Safe Level' of 19.5%, as provided by the Safe Work Australia document referenced above, will provide a conservative equivalent measurement length; see discussion below.

The excerpt shown in Figure 3 is taken from Institute of Chemical Engineers Symposium Series No. 154 Paper 153 '*A Consistent Approach to the Assessment and Management of Asphyxiation Hazards*' and provides a description of the effects and symptoms that are experienced at exposure to atmospheres of varying oxygen concentration. This information can be used to correlate the consequences of low oxygen atmospheres to the thermal radiation contours defined in AS/NZS 2885.6.

For example, a thermal radiation level of 4.7 kW/m^2 will cause injury (at least second degree burns) after 30 seconds exposure, which can be correlated to a 10% oxygen concentration which will cause fainting, nausea or inability to move freely. A thermal radiation level of 12.6 kW/m^2 represents the threshold of fatality for normally clothed people, which can be correlated to a 6% oxygen concentration which can cause a coma or death after 40 seconds exposure. These concentration limits are reached at distances well below that for the minimum 'Safe Level' of 19.5% determined above, as the oxygen concentration decreases as the distance from the pipeline decreases.

However, the decision was made in the case of this project not to revise the calculation for nitrogen

release distance as the the distance corresponding to 19.5% and 10% oxygen concentrations are of similar magnitude to the 4.7kW/m^2 and 12.6kW/m^2 gas radiation distances, and therefore reduction of the nitrogen release concentration limit (and resulting reduction in release distance) will not affect the location class applied to the pipeline for this SMS.

Oxygen (vol%)	Effects and symptoms
23.5	Maximum "safe level" (23% is often the high level alarm set point for most oxygen detectors).
21	Typical O_2 concentration in air.
19.5	Minimum "safe level" (19% is often the low level alarm set point for most O_2 detectors).
15–19	First sign of hypoxia. Decreased ability to work strenuously. May induce early symptoms in persons with coronary, pulmonary or circulatory problems.
12–14	Respiration increases with exertion, pulse up, impaired muscular coordination, perception and judgement.
10–12	Respiration further increases in rate and depth, poor judgement, blue lips.
8–10	Mental failure, fainting, unconsciousness, ashen face, blueness of lips, nausea, vomiting, inability to move freely.
6–8	6 minutes – 50% probability of death 8 minutes – 100% probability of death.
4–6	Coma in 40 seconds, convulsions, respiration ceases, death.
When a person enters an oxygen deprived atmosphere, the oxygen level in the arterial blood drops to a low level within 5 to 7 seconds. Loss of consciousness follows in 10 to 12 seconds and if the person does nor receive any oxygen within 2 to 4 minutes, heart failure and death follow.	
Moving affected and unconscious persons from a nitrogen atmosphere into fresh air is not enough to promote recovery. The patient has to be physically resuscitated in order to restore the oxygen supply to the brain.	

(Data complied from: IGC Doc 44/00/E and US Chemical Safety Board Safety Bulletin 2003)

Figure 3 – Effects of reduced oxygen atmospheres

APPENDIX 3D LOCATION CLASS

The primary location classification for the Cringila Lateral Pipeline is *Residential (T1), with a* secondary location class of *Heavy Industrial (HI).*

APPENDIX 4 DATABASE REPORTS

GPA ENGINEERING

Contents

Pipelines and Sections

Pipelines

Name	Length	Design Life	Fluid	Operational Status	Year Constr.
Port Kembla Pipeline	11.87 km		LNG		
(Out of Scope) Cringila Lateral Pipeline	0.161 km		Nitrogen		

Port Kembla Pipeline Sections

		Location Class:
000.000 - 000.281	**PKGT ORF to PKCT Road 1 - Trench**	T1 - HI

Land Use: AIE owned Onshore Receiving Facility (ORF)

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched easement in AIE owned Onshore Receiving Facility (ORF) within the Port Kembla Coal Terminal (PKCT).
AIE allotment comprising above ground piping at facility, internal roads and carparks, offices.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m

4.7 kW/m2 Radiation Contour: 650 m

Minimum Burial Depth: 1200 mm

MAOP: 14.895 MPag

MOP: 14.895 MPag

Maximum Operating Temperature: 65 °C

Minimum Operating Temperature: -10 °C

000.281 - 000.562 **PKCT Road 1 - HDD** T1 - HI

Land Use: Road verge in Industrial Area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
HDD section under underground conveyor and within the road verge in Port Kembla Coal Terminal (PKCT).
Depth of cover >10m for majority of this section.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1200 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

000.562 - 001.361 **PKCT Road 1 - Trench** T1 - HI

Land Use: Road pavement in Industrial Area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched installation within Port Kembla Coal Terminal (PKCT) Road 1. Pipeline follows road alignment which is adjoined by office blocks and car parks.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1500 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

001.361 - 001.639 **Gurungaty Waterway Crossing - HDD** T1 - HI

Land Use: Industrial land, road, waterway

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
HDD section under Gurungaty Waterway. Exit pit adjacent Graincorp silos and Graincorp offices.
Depth of cover >10m for majority of this section.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

001.639 - 002.500 **Gurungaty Waterway Crossing to Pacific Railway Crossing - Trench** T1 - HI

Land Use: Road verge / pavement in Industrial Area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched section installed in road easement of Tom Thumb Rd.
Adjacent land comprises car parks and train line.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

002.500 - 002.654 **Pacific Railway Crossing - HDD** T1 - S HI

Land Use: Industrial land

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
HDD under rail line.
Sensitive location class applied from KP 2.5 to KP 3.1 for Coniston Public School.
Depth of cover at rail crossing is ~10m.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

002.654 - 003.022 **Pacific Railway Crossing to Northgate Rd Crossing - Trench** T1 - S HI

Land Use: Bluesope "parkland" in industrial area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched section within verge owned by Bluescope.
Sensitive location class applied from KP 2.5 to KP 3.1 for Coniston Public School.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

003.022 - 003.301 **Northgate Rd Crossing - HDD** T1 - S HI

Land Use: Bluesope "parkland" in industrial area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
HDD section within verge owned by Bluescope, crossing Gate Rd (entrance to Bluescope visitor center and carpark).
Sensitive location class applied from KP 2.5 to KP 3.1 for Coniston Public School.
Depth of cover >10m for majority of this section.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

003.301 - 003.717 **Northgate Rd Crossing to South Coast Line - Trench** T1 - HI

Land Use: Bluesope "parkland" in industrial area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched section within Bluescope's property, adjacent visitor centre and rail line.
The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

003.717 - 004.089 **Springhill Rd Crossing - HDD** T1 - HI

Land Use: Public land in Industrial Area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
HDD section crossing 2 x rail lines, dense bushland and Springhill Rd. Exit pit to the west of Springhill Road.
Depth of cover >10m for majority of this section and up to >20m at maximum depth.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

004.089 - 004.999 **Springhill Rd Crossing to Bluescope Entry Rd - Trench** T1 - HI

Land Use: Powerline corridor in Industrial Land

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched section in Bluescope owned parcel between Springhill Rd and industrial land. Pipeline parallels overhead powerline and power poles.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

004.999 - 005.064 **Bluescope Entry Rd - Bored** T1 - HI

Land Use: Industrial Area

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Bored section crossing Bluescope Facility entry road.
The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

005.064 - 005.183 **Bluescope Entry Rd to Bluescope Carpark - Trench** T1 - HI

Land Use: Industrial Land

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched section in verge between industrial use land and Springhill Rd. On other side of Springhill Rd there is Bluescope Steelworks.
The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

005.183 - 005.376 **Bluescope Carpark - HDD** T1 - HI

Land Use: Industrial Land

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
HDD under Linfox truck yard.
Depth of cover >8m for majority of this section.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

005.376 - 005.590 **Bluescope Carpark to Allans Creek Crossing - Trench** T1 - HI

Land Use: Industrial Land

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trench section in verge between Linfox site and Springhill Rd.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

005.590 - 005.931 **Allans Creek Crossing - HDD** T1 - HI

Land Use: Industrial Land

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
HDD crossing Allans Creek and Springhill Overpass Rd. Exit pit at Cringila.
Dpeth of cover >15m for majority of this section and up to 21m at maximum depth.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

005.931 - 006.224 **Allans Creek Crossing to Segment 1/Segment 2 Tie-in - Trench** T1 - HI CIC

Land Use: Industrial Land

Location Class Discussion: Location Class from Alignment Sheets (Rev E)
Trenched section at Cringila, Nearby land comprises BOC plant, and industrial businesses/warehouses, rail line, recreation oval.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

006.224 - 006.492 **Segment 1/Segment 2 tie-in to Five Islands Road - Trench** T1 - HI CIC

Land Use: Light industrial, warehouses

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
Trenched section at Cringila, Nearby land comprises BOC plant, and industrial businesses/warehouses, rail line, recreation oval.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1200 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

006.492 - 006.826 **Five Islands Rd to Waynote Place - HDD** T1 - HI CIC

Land Use: Light industrial, warehouses

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
HDD under Five Islands Road and Industrial Block - exit point South West of Waynote Place Roundabout,
HDD depth under Five Islands Road <15m, and ~15m under Waynote Place

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1200 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

006.826 - 007.320 **Waynote Place to Lathe Place - Trench** T1 - HI CIC

Land Use: Vacant land in Industrial Area

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
Vacant Lot in Industrial Area (Shinagawa Refractories)
PKP line is laid adjacent to existing Jemena Port Kembla Lateral Gas Pipeline, in a common easement.
Pipeline is easement is parallel to power poles and also crossed by a number of HV transmission lines.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

007.320 - 007.760 **Lathe Place to Berkeley Road - HDD** T1 - HI CIC

Land Use: Light industrial precinct

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
HDD Section under industrial precinct from Lathe Place and Berkeley Road.
PKP line alignment follows existing Jemena Port Kembla Lateral Gas Pipeline.
Depth of installation up to 15m for majority of section.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

007.760 - 008.530 **Berkeley Road to Nolan Street - Trench** T1 - I CIC

Land Use: Parkland

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
Trenched easement in undeveloped council land and then Princes Motorway Road Reserve.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1200 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

008.530 - 008.580 **Nolan Street Bored Crossing - Bored** T1 - I CIC

Land Use: Parkland, residential

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
Bored crossing under Nolan St, approx. 4m depth.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1200 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

008.580 - 008.854 **Nolan Street to Princes Motorway - Trench** T1 - S I

Land Use: Parkland, residential

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
Trenched easement in undeveloped council land and then Princes Motorway Road Reserves.
Sensitive land use applied from KP8.6 to KP9.8 for future health precinct development bounded by Warwick St, Princes Motorway and Nottingham St.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

008.854 - 009.800 **Princes Motorway to Illawarra Railway - HDD** T1 - S I

Land Use: Industrial Precinct

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
Sensitive land use applied from KP8.6 to KP9.8 for future health precinct development bounded by Warwick St, Princes Motorway and Nottingham St.
HDD Section under industrial precinct from Princes Motorway to Princes Highway / Illawarra Railway.
Depth of installation >15m for majority of section.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

009.800 - 011.870 **Illawarra Railway to Kembla Grange Meter Station - Trench** T1 - I CIC

Land Use: parkland, sporting fields, public recreation activities

Location Class Discussion: Location Class from Alignment Sheets (Rev F)
Pipeline installed in council land adjacent to the Illawarra Railway Reserve.
PKP line is laid adjacent to existing Jemena Port Kembla Lateral Gas Pipeline, in a common easement.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 Port Kembla Pipeline
0.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 16.55 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

(Out of Scope) Cringila Lateral Pipeline Sections

Location Class:

000.000 - 000.023 **BOC to Five Islands Rd - Trench** T1 - HI

Land Use: Storage/laydown yard, adjacent oval used for recreational activities.

Location Class Discussion: Location Class from Alignment Sheets (Rev B)
Located in Bluescope owned land parcel, adjacent rail line and recreation oval.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 (Out of Scope) Cringila Lateral Pipeline
1.

12.6 kW / m2 Radiation Contour: 397 m
MAOP: 14.895 MPag
4.7 kW/m2 Radiation Contour: 650 m
MOP: 14.895 MPag
Minimum Burial Depth: 1200 mm
Maximum Operating Temperature: 65 °C
Minimum Operating Temperature: -10 °C

000.023 - 000.125 **Five Islands Rd - HDD** T1 - HI

Land Use: Multi-lane highway.

Location Class Discussion: Location Class from Alignment Sheets (Rev B)
Trenched section at Cringila, under Five Islands Rd.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 (Out of Scope) Cringila Lateral Pipeline
1.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1200 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

000.125 - 000.161 **Five Islands Rd to Cringila - Trench** T1 - HI

Land Use: Industrial businesses and warehouses.

Location Class Discussion: Location Class from Alignment Sheets (Rev B)
Located on BOC owned land parcel.

The design pressure of this pipeline is 16.55MPag to accommodate future EGP MAOP upgrade.

Predominant Pipe Design: 1 (Out of Scope) Cringila Lateral Pipeline
1.

12.6 kW / m2 Radiation Contour: 397 m **MAOP:** 14.895 MPag

4.7 kW/m2 Radiation Contour: 650 m **MOP:** 14.895 MPag

Minimum Burial Depth: 1200 mm **Maximum Operating Temperature:** 65 °C

Minimum Operating Temperature: -10 °C

Pipe Details

10. Port Kembla Pipeline

Material Type / Spec: API 5L X65

Design Pressue: 16.55 MPag

Design Factor: 0.62

Design Min Temperature: -10 °C

Design Max Temperature: 65 °C

Main-line Coating: 2LFBE; HDD sections include Abrasion Resistant Overcoat

Field-joint Coating: Epoxy or high build liquid epoxy

Outer Diameter: 457 mm

Wall Thickness: 13.5 mm

Corrosion Allowance: 0 mm

Manufacturing Tolerance: 0 mm

SMYS (de-rated if required): 450 MPa

Critical Defect Length (at MAOP): 156 mm

Resistance to Penetration

Minimum Excavator Size to Penetrate
B=0.75
a) General Purpose Teeth - >55t
b) Single Point Tiger Tooth - >55t
c) Simultaneous Twin Point Tiger Teeth - >55t
d) Minimum excavator to rupture (tooth length > CDL) - >55t
e) Minimum excavator for "no rupture" (tooth length > 2/3.CDL) - >55t
B=1.3
a) General Purpose Teeth - >55t
b) Single Point Tiger Tooth - 55t
c) Simultaneous Twin Point Tiger Teeth - >55t
d) Minimum excavator to rupture (tooth length > CDL) - >55t
e) Minimum excavator for "no rupture" (tooth length > 2/3.CDL) - >55t

Comments

Material details and MAOP from Design Basis GAS-556-DG-DN-001
Measurement Length from Radiation Contour Calculation GAS-556-CA-PL-004
CDL from Critical Defect Length calculation GAS-556-CA-ME-001. CDL shown is CDL at 16.55MPag for material toughness of 186J as specified in the line pipe specification. Maximum axial through wall defect for no rupture is 104mm at Design Pressure. CDL for MAOP (14.895 MPag) at 62J is 181mm. Maximum axial through wall defect for no rupture is 121mm at MAOP.

Resistance to Penetration - refer calculation GAS-556-CA-ME-002 EGP
Min. design factor of 0.67 for assemblies.
Min. design factor of 0.72 for pipeline.

11. (Out of Scope) Cringila Lateral Pipeline

Material Type / Spec: API 5L X65

Design Pressue: 16.55 MPag

Outer Diameter: 457 mm

Wall Thickness: 13.5 mm

Design Factor:	0.62	**Corrosion Allowance:**	0 mm
Design Min Temperature:	-19 °C	**Manufacturing Tolerance:**	0 mm
Design Max Temperature:	55 °C	**SMYS (de-rated if required):**	450 MPa
Main-line Coating:	2LFBE; HDD sections include Abrasion Resistant Overcoat	**Critical Defect Length (at MAOP):**	156 mm
Field-joint Coating:	Epoxy or high build liquid epoxy		

Resistance to Penetration

Minimum Excavator Size to Penetrate
B=0.75
a) General Purpose Teeth - >55t
b) Single Point Tiger Tooth - >55t
c) Simultaneous Twin Point Tiger Teeth - >55t
d) Minimum excavator to rupture (tooth length > CDL) - >55t
e) Minimum excavator for "no rupture" (tooth length > 2/3.CDL) - >55t
B=1.3
a) General Purpose Teeth - >55t
b) Single Point Tiger Tooth - 55t
c) Simultaneous Twin Point Tiger Teeth - >55t
d) Minimum excavator to rupture (tooth length > CDL) - >55t
e) Minimum excavator for "no rupture" (tooth length > 2/3.CDL) - >55t

Comments

Material details and MAOP from Design Basis GAS-556-DG-DN-01
Measurement Length from Radiation Contour Calculation GAS-556-CA-PL-004
Nitrogen release calculation ('Measurement Length') GAS-558-CA-PL-001
CDL from Critical Defect Length calculation GAS-556-CA-ME-001. CDL shown is CDL at 16.55MPag for material toughness of 186J as specified in the line pipe specification. Maximum axial through wall defect for no rupture is 104mm at Design Pressure. CDL for MAOP (14.895 MPag) at 62J is 181mm. Maximum axial through wall defect for no rupture is 121mm at MAOP.
Resistance to Penetration - refer calculation GAS-556-CA-ME-002 EGP
Min. design factor of 0.67 for assemblies.
Min. design factor of 0.72 for pipeline.

Typical Features Designs

TYP-5.11-Facilities — Facilities (Structural Threats)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.11 Facilities (Structural Threats)
Line Pipe: Standard Wall (13.5mm WT) minimum
Pipe and Fittings: Per piping specification and Mechanical Drawings
Cover: 1200mm minimum
Fencing: Full Security, 1.8m tall
Site level: Elevated 200mm above surrounding land
Site finish: 10mm gravel surface within fenced area, 100mm thick
Access: Formed road, perimeter internal road, personnel and second vehicle access gates
Valves: Major valves locked, minor valves unlocked but plugged
Control Hut: Steel framed, clad, no windows, access door locked, air conditioned
Communications: Major inlet, outlet and compressor stations continually monitored by SCADA
Security: Gate/control hut door open alarm, IR beams for some sites

Threat Assessments

N-006-XFR	Facilities - External fire (except major bushfire)
N-008-CFR	Facilities - Control hut fire
O-002-MGL	Facilities - Minor gas leak
N-009-GRS	Facilities - Ground settlement
N-010-TRE	Facilities - Tree fall
E-021-VEX	Facilities - Vehicle impact (external)
N-011-FLD	Facilities - flooding
I-001-INT	Facilities - Vandalism

References

N/A

Actions

N/A

TYP-5.1-Rural General Installation in Rural Areas / Field Areas

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.1 General Installation in Rural Areas / Field Crossing
Pipe - Standard Wall 13.5mm
Minimum DoC = 1200mm (as built generally TBA)
Signage - Warning signs in accordance with the Design Basis (at fences, road crossings, changes in direction and otherwise inter-visible)
Marker tape to be installed for all trenched sections.

Threat Assessments

References

2 GAS-599-PH-RM-001 - EGP Risk Assessment of Common Threats to Standard Designs

Actions

N/A

TYP-5.2a-Road Road Crossing

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.2 Road Crossing
Pipe: 13.5mm WT under road pavement, table drains and any anticipated road widening
Minimum DoC = 1200mm minimum within road reserve, except 750mm minimum permitted under table drain invert
Signage - Warning signs at each side of road
Marker Tape - Marker tape across full width of road reserve and beyond, except for bored section of bored crossings
Slab - Concrete slabs under table drains if cover < 1200mm (open-cut crossings only)

Threat Assessments

D-004-RDL	Vehicle load - road crossing
D-005-DRL	Vehicle load - drain
D-006-MNL	Maintenance machinery load - roads / rail
E-005-VEH	Vehicle contacts buried pipe
E-006-DRM	Table drain maintenance - road and rail reserves
D-007-RDC	Road or railway construction - equipment loads
E-007-RDC	Road construction - Northcliffe Dr
D-008-RWY	Rail traffic load (normal operation and accidents)

References

2 GAS-599-PH-RM-001 - EGP Risk Assessment of Common Threats to Standard Designs

Actions

N/A

TYP-5.2b-Road Reserve — Road Reserve (Unconstructed)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.2 Road Crossing
Pipe: Standard wall (13.5mm WT) .
Minimum DoC = 1200mm minimum
Signage - Warning signs at each side of road
Marker tape to be installed for all trenched sections.

Threat Assessments

D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
D-007-RDC	Road or railway construction - equipment loads
E-007-RDC	Road construction - Northcliffe Dr
D-002-VBG	Vehicle bogged over pipe
E-005-VEH	Vehicle contacts buried pipe

References

N/A

Actions

N/A

TYP-5.3-Rail — Railway

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.3 Railway
Pipe: Standard wall (13.5mm WT) .
Minimum DoC = 1200mm minimum
Signage - Warning signs at each side of road

Threat Assessments

D-006-MNL	Maintenance machinery load - roads / rail
D-007-RDC	Road or railway construction - equipment loads
D-008-RWY	Rail traffic load (normal operation and accidents)
E-008-RWY	Rail locomotive or carriage contacts pipe

References

N/A

Actions

N/A

TYP-5.5a-Minor Watercourse — Minor Watercourse

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.5 Minor Watercourse
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 1200mm minimum
Signage - TBA
Other - n/a
Marker tape to be installed for all trenched sections.

Threat Assessments

N-002-FLO Minor erosion at water course

References

N/A

Actions

N/A

TYP-5.5b-Major Watercourse — Major Watercourse

Pipe Design: Port Kembla Pipeline

Design Description: Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = ~10000mm minimum
Signage - TBA
Other - n/a
Installed by HDD

Threat Assessments

N-015-FLO Major erosion at river/creek crossing

References

N/A

Actions

N/A

TYP-5.6-Drain — Manmade Open Drain / Drain Subject to Maintenance

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.6 Manmade Open Drain / Drain Subject to Maintenance
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 750mm minimum
Signage - TBA
Other - n/a
Marker tape to be installed in all trenched sections.

Threat Assessments

N-002-FLO	Minor erosion at water course
D-006-MNL	Maintenance machinery load - roads / rail
E-006-DRM	Table drain maintenance - road and rail reserves
D-005-DRL	Vehicle load - drain
E-025-LMA	Vegetation and land maintenance

References

N/A

Actions

N/A

TYP-5.7a-Buried Utility - Gas — Buried Utility (Crossing or Parallel)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.7 Buried Utility (Crossing or Parallel)
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 300mm minimum separation below utility at crossings; 1200mm minimum cover at road crossings; 750mm minimum cover elsewhere
Signage - particularly at road crossings
Marker Tape - all locations except HDD or Bored crossings
Other - Lateral separation 300mm minimum (parallel service)

Threat Assessments

D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
E-013-HDD	Minor Utility installation - HDD
E-010-UMA	Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)
D-002-VBG	Vehicle bogged over pipe
D-004-RDL	Vehicle load - road crossing
D-006-MNL	Maintenance machinery load - roads / rail
E-002-UTL	Utility (local) and water pipe installation using excavators

References

N/A

Actions

N/A

TYP-5.7b- Buried Utility - Electrical

Buried Utility (Crossing or Parallel)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.7 Buried Utility (Crossing or Parallel)
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 300mm minimum separation below utility at crossings; 1200mm minimum cover at road crossings; 750mm minimum cover elsewhere
Signage - particularly at road crossings
Marker Tape - all locations except HDD or Bored crossings
Other - Lateral separation 300mm minimum (parallel service)

Threat Assessments

E-013-HDD	Minor Utility installation - HDD
D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
E-010-UMA	Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)
D-006-MNL	Maintenance machinery load - roads / rail
E-002-UTL	Utility (local) and water pipe installation using excavators
D-002-VBG	Vehicle bogged over pipe
D-004-RDL	Vehicle load - road crossing

References

N/A

Actions

N/A

TYP-5.7c-Buried Utility - Comms

Buried Utility (Crossing or Parallel)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.7 Buried Utility (Crossing or Parallel)
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 300mm minimum separation below utility at crossings; 1200mm minimum cover at road crossings; 750mm minimum cover elsewhere
Signage - particularly at road crossings
Marker Tape - all locations except HDD or Bored crossings
Other - Lateral separation 300mm minimum (parallel service)

Threat Assessments

D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
E-010-UMA	Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)
E-013-HDD	Minor Utility installation - HDD
D-002-VBG	Vehicle bogged over pipe
D-004-RDL	Vehicle load - road crossing
E-002-UTL	Utility (local) and water pipe installation using excavators
D-006-MNL	Maintenance machinery load - roads / rail

References

N/A

Actions

N/A

TYP-5.7d-Buried Utility - Stormwater

Buried Utility (Crossing or Parallel)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.7 Buried Utility (Crossing or Parallel)
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 300mm minimum separation below utility at crossings; 1200mm minimum cover at road crossings; 750mm minimum cover elsewhere
Signage - particularly at road crossings
Marker Tape - all locations except HDD or Bored crossings
Other - Lateral separation 300mm minimum (parallel service)

Threat Assessments

D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
E-010-UMA	Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)
E-013-HDD	Minor Utility installation - HDD
D-002-VBG	Vehicle bogged over pipe
D-004-RDL	Vehicle load - road crossing
E-002-UTL	Utility (local) and water pipe installation using excavators
D-006-MNL	Maintenance machinery load - roads / rail

References

N/A

Actions

N/A

TYP-5.7e-Buried Utility - Sewer

Buried Utility (Crossing or Parallel)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.7 Buried Utility (Crossing or Parallel)
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 300mm minimum separation below utility at crossings; 1200mm minimum cover at road crossings; 750mm minimum cover elsewhere
Signage - particularly at road crossings
Marker Tape - all locations except HDD or Bored crossings
Other - Lateral separation 300mm minimum (parallel service)

Threat Assessments

D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
E-010-UMA	Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)
E-013-HDD	Minor Utility installation - HDD
D-002-VBG	Vehicle bogged over pipe
D-004-RDL	Vehicle load - road crossing
D-006-MNL	Maintenance machinery load - roads / rail
E-002-UTL	Utility (local) and water pipe installation using excavators

References

N/A

Actions

N/A

TYP-5.7f-Buried Utility - Water

Buried Utility (Crossing or Parallel)

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.7 Buried Utility (Crossing or Parallel)
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 300mm minimum separation below utility at crossings; 1200mm minimum cover at road crossings; 750mm minimum cover elsewhere
Signage - particularly at road crossings
Marker Tape - all locations except HDD or Bored crossings
Other - Lateral separation 300mm minimum (parallel service)

Threat Assessments

D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
E-010-UMA	Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)
E-013-HDD	Minor Utility installation - HDD
D-002-VBG	Vehicle bogged over pipe
D-004-RDL	Vehicle load - road crossing
D-006-MNL	Maintenance machinery load - roads / rail
E-002-UTL	Utility (local) and water pipe installation using excavators

References

N/A

Actions

N/A

TYP-5.8-Overhead Power

Overhead Power

Pipe Design: Port Kembla Pipeline

Design Description: Refer to GAS-599-PH-RM-001 Section 5.8 Overhead Power
Pipe: Standard Wall (13.5mm WT) .
Minimum DoC = 1200mm minimum
Signage - as per AS 2885
Marker tape to be installed for all trenched sections.

Threat Assessments

D-001-VLD	Vehicle crossing pipe (firm ground surface) - other than road crossings
E-015-PPR	Power pole replace or duplicate
E-017-PPI	Power pole installation (new powerlines or services)
C-007-INV	AC corrosion due to induced voltages
C-008-STR	Stray Current Corrosion
D-006-MNL	Maintenance machinery load - roads / rail
D-011-POW	Maintenance of power lines within the pipeline easement (vehicle loads)

References

N/A

Actions

N/A

GPA ENGINEERING

Threat Assessment Summary

Name	Credible	Controlled	Can Fail	Risk Level	ALARP	Action Numbers
C-001-EXT - External Corrosion - Buried Pipeline	YES	YES	-	-	-	-
C-002-INT - Internal Corrosion due to contaminants (including MIC)	YES	YES	-	-	-	-
C-003-ERO - Internal Erosion	YES	YES	-	-	-	-
C-004-SCC - Stress Corrosion Cracking	YES	YES	-	-	-	-
C-005-EXT - Facilities - external corrosion - above ground pipe	YES	YES	-	-	-	-
C-006-TRN - Facilities - external corrosion - AG/BG transitions	YES	YES	-	-	-	-
C-007-INV - AC corrosion due to induced voltages	YES	YES	-	-	-	-
C-008-STR - Stray Current Corrosion	YES	YES	-	-	-	-
C-009-TEL - Telluric Current Corrosion	YES	YES	-	-	-	-
D-001-VLD - Vehicle crossing pipe (firm ground surface) - other than road crossings	YES	YES	-	-	-	-
D-002-VBG - Vehicle bogged over pipe	YES	YES	-	-	-	-
D-003-LFL - Landfill	YES	YES	-	-	-	-
D-004-RDL - Vehicle load - road crossing	YES	YES	-	-	-	-
D-005-DRL - Vehicle load - drain	YES	YES	-	-	-	-
D-006-MNL - Maintenance machinery load - roads / rail	YES	YES	-	-	-	-
D-007-RDC - Road or railway construction - equipment loads	YES	YES	-	-	-	-
D-008-RWY - Rail traffic load (normal operation and accidents)	YES	YES	-	-	-	-
D-009-GEN - General Design, Materials and Construction Threats	YES	NO	NO	-	-	2021-FEED-006
D-010-HDD - HDD loads	YES	YES	-	-	-	-
D-011-POW - Maintenance of power lines within the pipeline easement (vehicle loads)	YES	YES	-	-	-	-

Name	Credible	Controlled	Can Fail	Risk Level	ALARP	Action Numbers
D-012-RDL - Vehicle load - road crossing	YES	YES	-	-	-	-
D-013-HYD - Pipeline operation in hydrogen service	YES	NO	NO	-	-	-
D-014-CNS - Consequential rupture	NO	-	-	-	-	-
E-001-FNC - Fencing Activities	YES	YES	-	-	-	-
E-002-UTL - Utility (local) and water pipe installation using excavators	YES	YES	-	-	-	-
E-003-DAM - Dam Construction, Maintenance or Extension	NO	-	-	-	-	-
E-004-WAT - Water bores installation	NO	-	-	-	-	-
E-005-VEH - Vehicle contacts buried pipe	YES	NO	NO	-	-	-
E-006-DRM - Table drain maintenance - road and rail reserves	YES	YES	-	-	-	-
E-007-RDC - Road construction - Northcliffe Dr	YES	YES	-	-	-	-
E-008-RWY - Rail locomotive or carriage contacts pipe	YES	NO	NO	-	-	-
E-010-UMA - Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)	YES	YES	-	-	-	-
E-011-UMB - Buried utility maintenance - BELOW NEW PIPELINE (crossing or parallel)	YES	YES	-	-	-	2021-DD-009
E-012-CBL - Comms Cable Installation - Cable Plough	NO	-	-	-	-	-
E-013-HDD - Minor Utility installation - HDD	YES	YES	-	-	-	-
E-014-SEW - Deep sewer or stormwater drain install	NO	-	-	-	-	-
E-015-PPR - Power pole replace or duplicate	YES	YES	-	-	-	2021-FEED-002
E-017-PPI - Power pole installation (new powerlines or services)	YES	NO	NO	-	-	-
E-018-AGR - Agricultural activities - shallow	NO	-	-	-	-	-
E-021-VEX - Facilities - Vehicle impact (external)	YES	NO	NO	-	-	2021-FEED-001, 2021-DD-007

Name	Credible	Controlled	Can Fail	Risk Level	ALARP	Action Numbers
E-022-VIN - Facilities - Vehicle (or dropped object) Impacts to Above-Ground Piping	YES	YES	-	-	-	-
E-023-BLS - Blasting	NO	-	-	-	-	-
E-024-EAR - Earthworks associated with new showroom at 9-11 Waynote Pl, Unanderra	NO	-	-	-	-	-
E-025-LMA - Vegetation and land maintenance	YES	YES	-	-	-	-
E-026-HDD - Major Utility Installation - HDD	YES	YES	-	-	-	-
E-027-TNK - Proposed tank farm development at land parcel DP1125445 (KP1.3)	YES	YES	-	-	-	-
E-028-UTL - Angled trenched pipeline immediately downstream of HDD-01 in PKCT	YES	YES	-	-	-	2021-DD-008
E-029-BLU - Utility installation in Bluescope land between KP4.3 and KP5	NO	-	-	-	-	-
E-030-PKGT - External Interference During Construction at PKGT	NO	-	-	-	-	-
I-001-INT - Facilities - Vandalism	YES	YES	-	-	-	2021-DD-015
I-002-TER - Terrorism	YES	YES	-	-	-	-
I-003-CYB - Cyber threats	YES	YES	-	-	-	-
N-001-PEA - Peat Fires	YES	YES	-	-	-	2021-FEED-007
N-002-FLO - Minor erosion at water course	YES	YES	-	-	-	2021-FEED-004
N-005-FIR - Fire - buried pipeline	YES	YES	-	-	-	-
N-006-XFR - Facilities - External fire (except major bushfire)	YES	YES	-	-	-	-
N-007-BFR - Facilities - Major bushfire	YES	YES	-	-	-	-
N-008-CFR - Facilities - Control hut fire	YES	YES	-	-	-	-
N-009-GRS - Facilities - Ground settlement	YES	YES	-	-	-	-
N-010-TRE - Facilities - Tree fall	NO	-	-	-	-	-

Name	Credible	Controlled	Can Fail	Risk Level	ALARP	Action Numbers
N-011-FLD - Facilities - flooding	NO	-	-	-	-	-
N-012-EQU - Earthquake	YES	YES	-	-	-	-
N-013-GRD - Ground Movement - landslip, mine subsidence, etc	NO	-	-	-	-	-
N-014-LTG - Lightning strike	YES	NO	YES	Low	-	-
N-015-FLO - Major erosion at river/creek crossing	YES	YES	-	-	-	-
O-002-MGL - Facilities - Minor gas leak	YES	YES	-	-	-	-
O-003-FTG - Fatigue due to pressure cycling	YES	YES	-	-	-	-
O-004-GEN - General Operations and Maintenance Threats	YES	YES	-	-	-	-

Threat Assessment Details

Legend

Threat is not credible	•
Failure not possible, or threat is controlled or negligible risk	✓
Threat is low risk or ALARP	✓
Assessment completed elsewhere	•
Threat is intermediate risk	✓
Threat assessment incomplete	•
Threat is ALARP or risk is high or extreme	✕

C-001-EXT External Corrosion - Buried Pipeline

Category: Corrosion

Description: Corrosion of the buried pipeline, due to the soil, resulting in loss of wall thickness and potential loss of containment.

Control by design and/or procedures

PIGGABLE PIPELINES
1) 2LFBE coating, HBE joint coating.
2) post-construction DCVG survey & repair
3) CP, CP monitoring
4) Pipeline to be designed for ILI nominal 10 year inspection intervals.
5) Damage by tree roots in minimised by vegetation management program.
6) The pipeline is protected from undetected coating defects (either construction defects or post-construction (e.g settling of pipeline a rock, tree roots, soil movement) by CP.
7) Corrosion protection effectiveness is assessed on an annual basis via the Annual EGP Corrosion Integrity Report, GAS-599-RP-IN-011

All buried valves will have tape wrap applied.

FOR BURIED STATION PIPEWORK - refer EGP Corrosion Integrity Report, GAS-599-RP-IN-011, Section 5.1 - No buried station pipework , all buried pipework is protected by the CP system.
DCVG Surveys.
Results assessed to determine if direct inspection and further DCVG are required.

Threat is controlled ✓

References

4 GAS-599-RP-IN-011 EGP Integrity Report - Corrosion

C-002-INT Internal Corrosion due to contaminants (including MIC)

Category: Corrosion

Description: Internal Corrosion due to contaminants (including MIC) - Impurities in liquid that may accumulate in the pipeline low points.

Control by design and/or procedures

Gas is sales gas quality. Gas quality will be monitored upstream at PKGT. Gas quality to conform to Jemena EGP Gas Specification.

The gas is cryogenically dry from the FSRU. Gas will have no contaminants.

Pipeline internally lined with epoxy coating per specification GAS-556-SP-PL-004, but this is provided for flow assurance not corrosion protection.

No internal coating on induction bends.

Threat is controlled ✓

References

35	GAS-556-SP-PL-004	Internal Coating Specification
4	GAS-599-RP-IN-011	EGP Integrity Report - Corrosion

C-003-ERO Internal Erosion

Category: Corrosion

Description: Erosion of the pipe due to high-velocity particulates, particularly at changes in direction.

Control by design and/or procedures

Erosion velocity has been considered by the design. Velocity limits are specficied in GAS-599-DG-DN-001.

Gas is sales quality gas - no erosion proporties/contaminants.

Threat is controlled ✓

References

29	GAS-599-DG-DN-001	Project Marlin: EGP Reversal Facilities Design Basis Manual

C-004-SCC Stress Corrosion Cracking

Category: Corrosion

Description: Stress corrosion cracking occurs when pipeline is subjected to a high stress and temperature range and corrosion effects.

Control by design and/or procedures

Refer pipeline basis of design GAS-556-DG-DN-001 Section 9.1.4
A stress corrosion cracking study has been documented in the Pipeline Design Report GAS-556-RP-PL-001. The risk level is considered low.

NOTE:
Pipeline is not high temperature (Max design temp 65C).
No SCC experienced historically on Jemena FBE coated pipelines.

Threat is controlled ✓

References

23	GAS-556-DG-DN-001	Port Kembla Pipeline Design Basis Manual
70	GAS-556-RP-PL-001	Port Kembla Pipeline - Pipeline Design Report

C-005-EXT Facilities - external corrosion - above ground pipe

Category: Corrosion

Description: External corrosion of above-ground pipe, due to corrosive environment (e.g. after rain, in crevices).

Control by design and/or procedures

Facilities piping is painted and periodically inspected.

Refer GAS-599-DG-DN-001 Section 4.2.
"All structural steel supports, skids, stairs and platforms shall be galvanised in accordance with Jemena Specification for Galvanising, GTS-960-SP-ME-013.
Above ground piping and steelwork, where not galvanised or constructed from stainless steel, shall be coated in accordance with Jemena Liquid Coating Specification for Above Ground Steel Assets, GTS-960-SP-ME-001. Buried carbon steel piping shall be coated using Ultra High Build Catalysed Epoxy in accordance with Jemena Piping Design Guide, GTS-960-DG-PI-001 Section 3.2.2.
Studbolt and nut coating is to be in accordance with Gas Facilities Bolting Coating Specification (GTS-960-SP-IN-001).
All hot or cold surfaces that can be accessed by personnel during normal operation shall be provided with insulation or guarding for personnel protection in accordance with Jemena Specification for Insulation of Piping and Equipment, GTS-960-SP-ME-009.
Appropriate signage and labelling will be provided in accordance with AS 1345."

EGP Corrosion Integrity Report, GAS-599-RP-IN-011 Section 4.2
"Monthly station checks are undertaken at scraper stations and MLVs to check for items listed in the station check sheets, an example of the station checklist can be found in ECMS
It is assumed the station checks will be extended to the new facilities on the Port Kembla Pipeline."

Threat is controlled ✓

References

29	GAS-599-DG-DN-001	Project Marlin: EGP Reversal Facilities Design Basis Manual
4	GAS-599-RP-IN-011	EGP Integrity Report - Corrosion
81	GTS-960-DG-PI-001	Piping Design Guide
82	GTS-960-SP-IN-001	Gas Facilities Bolting Coating Specificaiton
80	GTS-960-SP-ME-001	Liquid Coating Specification for Above Ground Steel Assets
83	GTS-960-SP-ME-009	Specification for insulation of Piping and Equipment
79	GTS-960-SP-ME-013	Specification for Galvanising

C-006-TRN Facilities - external corrosion - AG/BG transitions

Category: Corrosion

Description: Corrosion of the pipe steel at above-/below-ground transitions, due to pooling of water, abrasion from pipeline movement, or ingress at end of coating system.

Control by design and/or procedures

UV-resistant Abrasion resistant overcoat is applied over the FBE/HBE coatings on the transition (for abrasion at the transition). Typical above ground coating is a three coat paint spec (zinc primer and 2 top coats). For transition segments, just the 2 top coats are applied over the FBE/HBE.

Regular inspection of AG/UG transition points under O&M procedure - GAS-999-SP-PL-002 (Specification for pipe air/ground transition inspection).

Refer GAS-556-DG-DN-001, S9.3.7
"The above / below ground interface (600mm either side of finished surface level) shall be over-wrapped with protective tape or approved equivalent.
Induction bends coated with HBE."

Threat is controlled ✓

References

29	GAS-599-DG-DN-001	Project Marlin: EGP Reversal Facilities Design Basis Manual
84	GAS-999-SP-PL-002	Specification for pipe air/ground transition inspection

C-007-INV AC corrosion due to induced voltages

Category: Corrosion

Description: AC corrosion due to induced voltages

Control by design and/or procedures

Corrosion risk due to induced voltages has been assessed in Electrical Hazard Assessment Report GAS-556-RP-CP-002. The assessment determined the steady state induced voltage is expected to be below the AC corrosion limits provided in AS4853.
The pipeline will be protected by an Impressed Current CP system (tied into the existing EGP ICCP system).
SSD's are included in the standard design, and will be confirmed upon AC testing during commissioning. Ongoing monitoring processes to monitor AC interference.
Zinc ribbon nominated on the alignment sheets to provide additional shielding in areas of high risk.

The FSRU will have an ICCP system.
Reclaimed land from BHP steel works within PKGT site and lesser extent from the coal terminal. If unsuitable backfill is detected in construction, trench backfill will be imported.
Work in progress for interaction study between CP systems (wharf vs. pipeline).

Refer GAS-556-DG-DN-001, S9.4.1
"The protection system design, commissioning and monitoring will be in accordance with AS/NZS 3000 and AS 2832.1.
The design and installation of the CP will be carried out by suitably qualified and experienced personnel. Any interference or stray currents will be mitigated in accordance with AS 2832 or AS 2885.1.
The Cathodic Protection design will be reviewed in conjunction with the earthing design to ensure compliance with AS 4853 – Electrical Hazards on Metallic Pipelines."

EGP Corrosion Integrity Report, GAS-599-RP-IN-011 Section 2.3 and Section 8.3
1) AC interference is monitored via CP surveys - assumed to be consistent for the new Port Kembla Pipeline

Threat is controlled ✓

References

23	GAS-556-DG-DN-001	Port Kembla Pipeline Design Basis Manual
62	GAS-556-RP-CP-002	Electrical Hazard Assessment (AS4853) Study
4	GAS-599-RP-IN-011	EGP Integrity Report - Corrosion

C-008-STR Stray Current Corrosion

Category: Corrosion

Description: Stray current corrosion due to traction currents - Railway Crossings

Control by design and/or procedures

New railway crossing Tom Thumb Rd near gate to PKCT (KP2.6), HDD crossing near Springhill Rd (KP3.75), Springhill Rd Overpass (KP5.9) and at Illawarra Railway near Orana Pde (KP9.7). Overhead wires are present along train lines.
Impacts of stray current cannot be confirmed until during commissioning of the new CP system. Connections will be available at the nearest CP test point to each rail crossing for connection of a Transformer Rectifier Assisted Drainage (TRAD) unit should it be required.

The existing PKL has a TRAD unit, provision will be made in new pipeline and CP design for connection of a TRAD unit where the new line crosses the electrified rail. CP system interference will be measured and requirement for additional TRAD unit determined as part of commissioning. This is documented in the Cathod Protection Design report GAS-556-RP-CP-001.

Refer GAS-556-DG-DN-001, S9.4.1
"The protection system design, commissioning and monitoring will be in accordance with AS/NZS 3000 and AS 2832.1.
The design and installation of the CP will be carried out by suitably qualified and experienced personnel. Any interference or stray currents will be mitigated in accordance with AS 2832 or AS 2885.1, including assessment of the existing TRAD unit and review of need for additional units.
The Cathodic Protection design will be reviewed in conjunction with the earthing design to ensure compliance with AS 4853 – Electrical Hazards on Metallic Pipelines."

Threat is controlled ✓

References

23	GAS-556-DG-DN-001	Port Kembla Pipeline Design Basis Manual
63	GAS-556-RP-CP-001	Cathodic Protection Design Report

C-009-TEL Telluric Current Corrosion

Category: Corrosion

Description: Stray current corrosion due to telluric effects in general along the pipeline.

Commissioning of CP system to comply with AS2832.

Control by design and/or procedures

1) 2LFBE coating, HBE joint coating.
2) post-construction DCVG survey & repair
3) CP, CP monitoring
4) Pipeline to be designed for ILI nominal 10 year inspection intervals.
5) Damage by tree roots in minimised by vegetation management program.
6) The pipeline is protected from undetected coating defects (either construction defects or post-construction (e.g settling of pipeline a rock, tree roots, soil movement) by CP.
7) Corrosion protection effectiveness is assessed on an annual basis via the Annual EGP Corrosion Integrity Report, GAS-599-RP-IN-011

CP and CP monitoring is used to assess and limit any telluric effects and confirm compliance to AS2832.

Telluric effects will be confirmed as part of datalogger testing in commissioning. Based on the existing PKL, traction effects more significant compared to telluric

Threat is controlled ✓

References

23	GAS-556-DG-DN-001	Port Kembla Pipeline Design Basis Manual
4	GAS-599-RP-IN-011	EGP Integrity Report - Corrosion

D-001-VLD Vehicle crossing pipe (firm ground surface) - other than road crossings

Category: DesignDefects

Description: Activity: Vehicle crossing pipe (firm ground surface) at locations other than road crossing.
Threat: Excessive pipe stress causing denting/ovality of the pipe requiring repair

Control by design and/or procedures

Refer GAS-556-CA-PL-006
Calculations in accordance with API RP 1102 show that the maximum legal highway vehicle will induce a stress approximately 77% of the allowable stress if cover is 1200 mm. The stress level does not increase significantly as cover decreases to 750 mm. These results apply under the worst possible combination of soil conditions, and in most cases the soil conditions will be more favourable and the effective stress will be well within the allowable limit. It can be concluded that isolated vehicles driving across the pipe do not pose any significant threat of excessive pipe stress.

GAS-556-CA-PL-006 also included an assessment of pipe integrity under loading from a 300t crane outrigger (this type of crane is used for periodic maintenance in PKCT). The maximum stress for the pipe buried at 1200mm was determined ot be 70% which is less than the allowable 90%.

Threat is controlled ✓

References

26 GAS-556-CA-PL-006 Road Crossing Calculation

D-002-VBG Vehicle bogged over pipe

Category: DesignDefects

Description: Activity: Vehicle bogged over pipe
Who: Along the pipeline there is water infrastructure which is accessed by the water authority. Frequent lawn mowing in the region (Jemena easement, council land and cemetery). 4wd activity at the Kembla Grange end KP11-KP11.8.
Threat: Excessive pipe stress causing denting/ovality of the pipe requiring repair

Control by design and/or procedures

Refer GAS-599-PH-RM-001, Section 5.1.3.1
"A bogged vehicle may sink to its axles, but little further and hence will not penetrate the ground more deeply than half its wheel diameter. This is less than the minimum cover of 1200 mm so direct contact between the tyre and pipe is highly unlikely.
As the wheel sinks it will become closer to the pipe, but its load will be distributed over a broader area. For these conditions it is not possible to do a meaningful calculation of pipe stresses. A fully laden vehicle that has sunk to its axles may lead to pipe stress somewhat greater than the theoretical allowable limit. However it is not credible that this could lead to loss of pipe integrity."

Weekly patrols to assess condition of easement and any erosion / loss of cover.

Threat is controlled ✓

References

2 GAS-599-PH-RM-001 EGP Risk Assessment of Common Threats to Standard Designs

D-003-LFL Landfill

Category: DesignDefects

Description: Activity: Landfill
Threat: Excessive pipe stress causing denting/ovality of the pipe requiring repair

Can expect illegal dumping over the life of the pipe in same area as 4wd (KP11-KP11.8) but expected to be minor.

Control by design and/or procedures

Refer GAS-599-PH-RM-001, Section 5.1.3.5
Minor filling of land will not pose a threat to the pipeline. Additional stresses due to a few metres of additional cover will be insignificant. Landfill on a large scale (more than a few metres depth) is adequately controlled by the standard mitigation measures, and in any case is also unlikely to lead to unacceptable pipe stress.

Threat is controlled ✓

References

2 GAS-599-PH-RM-001 EGP Risk Assessment of Common Threats to Standard Designs

D-004-RDL Vehicle load - road crossing

Category: DesignDefects

Description: Activity: Vehicle loading on pavement (legal highway vehicles)
Threat: Excessive pipe stress

Control by design and/or procedures

Refer GAS-556-CA-PL-006
Calculations in accordance with API RP 1102 show that for 1200mm cover the effective stress is 77% of the allowable stress for the pipe. The allowable stress is 90% SMYS.
All major road crossings are HDD or bored crossings, so DoC >>1200mm

Threat is controlled ✓

References

26 GAS-556-CA-PL-006 Road Crossing Calculation

D-005-DRL Vehicle load - drain

Category: DesignDefects

Description: Activity: Vehicle off pavement, wheels in table drain. Also includes traffic accident - heavy vehicle falls or ploughs into table drain.
Threat: Excessive pipe stress

Relevant between KP11.5 and KP11.8 particularly near Kembla Grange MLV Station.

Control by design and/or procedures

For Port Kembla Pipeline, min DoC - 1200mm, slabs at drain inverts if cover <1200mm.

The following assessment was completed for the existing EGP. The Port Kembla Pipeline design is more conservative based on the pipe wall thickness (13.5mm).

Refer GAS-599-PH-RM-001, Section 5.2.3.2
"It is possible that effective stress may marginally exceed the allowable level, but it is nevertheless very unlikely that further consequences would follow. This condition is slightly outside the range covered by API 1102 and some extrapolation of data from API 1102 is necessary. Calculations on this basis suggest that effective pipe stress increases only insignificantly as cover under vehicle loading is reduced from 1200 mm to 750 mm (the dominant contributor to total stress is internal pressure; see calculation 500-DC-003).
The presence of concrete slabs if utilised would ensure that the stress levels are limited below any theoretically calculated value, although the magnitude of the stress is not easily estimated.
Trench backfill is always well compacted and there is no expectation that vehicle wheels will sink deep into the soil of the drain invert. The acceptability of the proposed design is reinforced by the fact that it is standard practice on pipelines throughout Australia."

Threat is controlled ✓

References

19 GAS-599-RP-RM-001 EGP Security Assessment

D-006-MNL Maintenance machinery load - roads / rail

Category: DesignDefects

Description: Activity: Maintenance machinery loading - e.g. graders, rollers
Threat: Excessive pipe stress

Control by design and/or procedures

Refer GAS-556-CA-PL-006
Calculations in accordance with API 1102 show that for 1200mm cover the effective stress is 77% of the allowable stress for the pipe. The allowable stress is 90% SMYS.
All major road crossings are HDD or bored crossings, so DoC >>1200mm

Refer GAS-599-PH-RM-001, Section 5.2.3.3
"Normal construction machinery does not impose greater loadings than the maximum highway vehicle, except for vibrating rollers. For large vibrating rollers it is possible that the effective stress may exceed the allowable, but unlikely that there would be further consequences. There is no calculation procedure comparable to that used for standard highway vehicles so calculations have not been done.
Regular pipeline patrols and contact with road / rail authorities mean that it is highly unlikely that substantial roadwork / rail maintenance could be done without Jemena being aware of it, so that appropriate liaison and inspection can be maintained while the work is in progress. "

Threat is controlled ✓

References

26	GAS-556-CA-PL-006	Road Crossing Calculation
2	GAS-599-PH-RM-001	EGP Risk Assessment of Common Threats to Standard Designs

D-007-RDC Road or railway construction - equipment loads

Category: DesignDefects

Description: Activity: Heavy machinery during future road or railway construction.
Threat: Excessive pipe stress causing denting/ovality, requiring repair

Control by design and/or procedures

1) Refer GAS-556-CA-PL-006 - Calculations in accordance with API 1102 show that for 1200mm cover the effective stress is 77% of the allowable stress for the pipe. The allowable stress is 90% SMYS.
2) All major road crossings are HDD or bored crossings, so DoC typically > 10m
3) Road or rail construction is a major project. These are non-routine activities carried out by large, well-resourced, competent organisations, and which require significant planning, formal consultation and regulatory approvals. This includes requirements for Jemena to provide input into the design process, approve crossing design and construction plans, and manage construction activities at the time of the project. This is addressed on a case by case basis, and includes Land Use Change and/or Encroachment SMS processes.

Threat is controlled ✓

References

26 GAS-556-CA-PL-006 Road Crossing Calculation

D-008-RWY Rail traffic load (normal operation and accidents)

Category: DesignDefects

Description: Activity: Rail car loading on tracks OR in rail reserve in the event of derailment
Threat: Excessive pipe stress causing denting/ovality, requiring repair

Control by design and/or procedures

Normal load:
Refer GAS-556-CA-PL-008
For the minimum cover of 4000 mm and WT 13.5mm calculations show that the effective stress is only 78% of the allowable value (see calculation GAS-556-CA-PL-008)
Rail crossings will be =>4m to meet rail authority requirements.

Accident:
Refer GAS-599-PH-RM-001, Section 5.3.3.2
"It is possible that effective stress may exceed the allowable level, but it is unlikely that further consequences would follow given the conservative margin between allowable stress (72% SMYS) and yield. This loading condition is outside the range covered by AS 4799 and API 1102 and specific calculations have not been done. The presence of concrete slabs would reduce the stress below any theoretically calculated value, although the magnitude of the reduction is not easily estimated. "

Threat is controlled ✓

References

27	GAS-556-CA-PL-008	Rail Crossing Calculation
2	GAS-599-PH-RM-001	EGP Risk Assessment of Common Threats to Standard Designs

D-009-GEN General Design, Materials and Construction Threats

Category: DesignDefects

Description:

Control by design and/or procedures

Jemena has established design and construction quality processes governed by the project execution plan (document no: GAS-599-PA-QA-001).

Key components of the QMP include:

Design:
-The Design Basis Manual (DBM) is written by an experienced senior engineer. The DBM is subject to Jemena's QA and approval process.
-All calculations, drawings, design reports, engineering assessments, plans and procedures are subject to Jemena's QA and approval process.
-The design is subject to risk assessments, review workshops, HAZOP, SMS, SIL studies as required.
-Design review is completed at key milestones throughout the design process.
-A formal design change process including documenting the design change, review by Jemena Project Engineer (and other Jemena personnel as nominated by the Project Manager) and written approval.

Materials:
-Construction Contractor will develop Materials Management Plan for Jemena approval.
-All materials will be subject to a receiving inspection to verify as a minimum that the items meet description, include the required markings, the required records are received, item is free of damage and thorough inspection of items to ensure compliance.
-The line pipe provider will operate a pipe tracking system ensuring full traceability of every pipe length to its particular heat number, slab, coil and all stages of the manufacturing process. A bar-code system will be used to track the final location of each pipe and incorporate this data to the Jemena GIS system.
-Storage and handling procedure will be in accordance with Jemena document GAS-499-PR-QA-001.

Construction:
-Construction will be managed according to a Construction Management Plan (CMP).
-Jemena Construction Superintendents, Inspection Personnel and other site representatives provide guidance and oversight to Construction personnel.
-Hold and Witness points will be agreed between the Construction Contractor and Jemena.
-Inspection processes are outlines in the QMP including Third Party Inspection at source of purchased products.
-Inspection and testing plans.
-As-built hydrotesting to AS/NZZS 2885.5 prior to commissioning.

Failure Analysis

Failure not possible ✓

Actions

2021-FEED-006	General Design, Materials and Construction Threats	Closed

References

88	GAS-499-PR-QA-001	Equipment Shipping and Handling Procedure
87	GAS-599-PA-QA-001	Marlin Project Quality Management Plan

D-010-HDD HDD loads

Category: DesignDefects

Description: Activity: HDD pipe installation
Threat: Overstress of the pipe during HDD pull process

Control by design and/or procedures

HDD designs have been completed with consideration of minimum bend radii and maximum installation stress. Refer HDD report (411010-00071-PL-REF-0003) for preliminary installation stress calculations. Results are that installation stress is less than the maximum allowable stress.

Notwithstanding this, confirmation of HDD installation stress for the final designs will be confirmed by the HDD contractor.

Design checks will be subject to quality review processes as set out in the Quality Management Plan.

Threat is controlled ✓

References

28	411010-00071-PL-REF-0003	Port Kembla Lateral Looping HDD Report (Pre-FEED Phase)
87	GAS-599-PA-QA-001	Marlin Project Quality Management Plan
1	GAS-599-RP-RM-014	Five Yearly SMS - Eastern Gas Pipeline

D-011-POW Maintenance of power lines within the pipeline easement (vehicle loads)

Category: DesignDefects

Description: Activity: New pipeline installed within existing power line easement between KP6.9 & KP7.3 (Segment 2) and KP4.3 & KP 5.0 (Segment 1). Maintenance of power assets may require large cranes.
Threat: Vehicle load in excess of maximum highway vehicle load designed for.

KP6.9 - KP7.3 (Segment 2)
Pipeline is installed in a Common Infrastructure Corridor area running parallel to power overhead powerlines.
Potential vehicle loads include large cranes (for power pole maintenance/installation).

KP4.3 - KP5.0 (Segment 1)
Pipeline parallels overhead powerlines.
Potential vehicle loads include large cranes (for power pole maintenance/installation).

Control by design and/or procedures

Power asset maintenance would be a planned activity by the power company and require liaison/planning.

KP4.3 - KP5.0 (Segment 1) and KP6.9 - K7.3 (Segment 2)
The ground is unpaved along this section and outriggers with pads to distribute load and stabilise crane are typically used. Furthermore, any work in this area by power utility would be a controlled activity with planning assessed on a case by case basis, including DBYD's and consultation with third party utility. Utility works crews are trained and experienced and are working to established procedures (including JHA etc).
Furthermore, an assessment for a 300t crane with outrigger located above the pipeline showed a maximum pipe stress of 70% for a DOC of 1200mm - Refer GAS-556-CA-PL-006.
Signage will also be installed adjacent power poles to notify of the presence of buried gas pipeline.

Threat is controlled ✓

References

26 GAS-556-CA-PL-006 Road Crossing Calculation

D-012-RDL Vehicle load - road crossing

Category: DesignDefects

Description: Activity: Vehicle loading on pavement (non highway legal vehicles). Segment 1 of pipeline is installed by open trench within roadway within Port Kembla Coal Terminal. Port vehicles identified to be non-highway legal vehicles (actual vehicles weights not currently known).
Threat: Excessive pipe stress

Control by design and/or procedures

Refer GAS-556-CA-PL-006
Calculations in accordance with API RP1102 show that for 1200mm cover the pipeline can accommodate single axle load up to 766kN and tandem axle load up to 1000kN. Additional assessment for a 300t crane outrigger above pipeline with 1200mm DOC has also been undertaken in GAS-556-CA-PL-006 and shown to be able to accommodate this loading without exceeding allowable stresses (result was 70% of SMYS).

Threat is controlled ✓

References

26 GAS-556-CA-PL-006 Road Crossing Calculation

D-013-HYD Pipeline operation in hydrogen service

Category: DesignDefects

Description: AIP have proposed to build a new power plant at Port Kembla that will be designed for initial operation up to 30% blended hydrogen/natural gas with the ability to transition to 100% hydrogen. There is a possibility that the PKP Pipeline will supply the natural gas/hydrogen for the power plant.
Pipeline operation in hydrogen service has implications for the material properties including material toughness, fracture control and fatigue.

Control by design and/or procedures

An investigation into the modfications to the current pipeline design to accommodate future hydrogen service has been completed in Doc No. GAS-556-RC-PL-002 - PKP Hydrogen Conversion Memorandum.

A summary of the changes to be applied to prepare the pipeline for future hydrogen service includes:
1. Keep samples from all pipe heats for further material testing (in hydrogen environment if possible) as the technology and research develops.
2. Increase the minimum charpy toughness to 186J at -10C.
3. Increase the mill test pressure and hydrostatic test pressure as much as possible to keep within Type 1 test.
4. Update the metal composition in the line pipe specification in line with the changes recommended in ASME B31.12 Appendix G.
5. Review the welding requirements and defect management requirements.

Failure Analysis

Failure not possible ✓

References

66 GAS-556-RC-PL-002 PKP Hydrogen Conversion Memorandum

D-014-CNS Consequential rupture

Category: DesignDefects

Description: Threat: Rupture of adjacent PKL Pipeline leading to rupture of the PKP Pipeline.

Not credible on the basis that PKL satisfies the requirements for "no rupture" (refer 2020 Eastern Gas Pipeline - 5 Yearly SMS Report, GAS-599-RP-RM-014, r1).

Threat is not credible

References

1	GAS-599-RP-RM-014	Five Yearly SMS - Eastern Gas Pipeline

E-001-FNC Fencing Activities

Category: ExternalInterference

Description: Activity: Fencing Activities
Threat: Auger or impact from driven poles causing dent/gouge requiring repair
Who: Landowner or fencing contractor
Equipment: Hand held post hole digger, auger fitted to light truck or small excavator (<10t), post hole driver.
Depth: If the fence post is replaced or a new one installed it would be buried to a depth of approx. 600mm. Strainer posts may go to 1000mm.
When / Frequency: as required.

Soil up to approx. 4-6m is softer uncontrolled fill/residual soil. Equipment used would be selected for the soil conditions i.e. light equipment, soft soil auger/drill heads. Therefore, contact with pipeline would be noticeable and equipment used unable to penetrate the pipe.

External interference controls

Physical: Burial:DoC = 1200mm provides absolute protection
Rail - 4000mm min. below rail
HDD Sections - >>1200mm
Wall Thickness:13.5mm WT can resist penetration light boring equipment or post ram/drivers

Procedural: Signs:As per AS2885. Signs on all fences. Intervisible.
Marker Tape:For trenched installation only.
Dial Before You Dig:Pipeline in registered on DBYD in NSW
Landowner Liaison:Regular liaison with Landowners, (refer GAS-599- PA-LM-001 / 002).
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002).
Activity Agreements:Easement agreements with each landowner, which restrict the activities permitted within the easement.
Patrolling:Limited effectiveness for this threat. Patrolling as per EGP PIMP GAS-599-PA-IN-002.
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly Aerial; Weekly road patrol

Threat is controlled ✓

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan

E-002-UTL Utility (local) and water pipe installation using excavators

Category: ExternalInterference

Description: Activity: Utility (local) and water pipe installation using excavators
Threat: Impact resulting in depth or gouge.
Who: Utility or contractor working for utility.
Equipment: Excavator up to 30t, fitted with GP or Tiger Teeth, but typically 10-12T with a flat bucket.
Depth: Typically installed 450-700mm cover
When / Frequency: At least monthly

A major fiber optic cable was recently installed through Waynote Place. The service was directionally drilled (HDD) and partly excavated (excavation at western side of waynote place) with a 5T excavator. The geotechnical report (GAS-556-RP-GI-001) identifies engineered fill and residual soil up to approx. 4-6m below surface. Equipment used for excavation/HDD would be selected for the soil conditions i.e. light equipment, flat buckets. Therefore, contact with pipeline would be a noticeable resistance during excavation and equipment used unable to penetrate the pipe.

External interference controls

Physical: Burial:DoC = 1200 provides absolute protection
Rail - 4000mm below rail
HDD Sections - >>1200mm
Wall Thickness:13.5mm WT can resist penetration for 30t excavators fitted with tiger teeth

Procedural: Signs:As per AS2885. Signs on all fences. Intervisible.
Marker Tape:For trenched installation only.
Dial Before You Dig:Pipeline in registered on DBYD in NSW
Landowner Liaison:Regular liaison with Landowners, (refer GAS-599- PA-LM-001 / 002).
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial
Other:In an urban environment there are numerous buried services so any party installing new services will be planning to identify all buried services. Incl. DBYD process, competent contractor, planning.

Threat is controlled ✓

References

39 GAS-556-RP-GI-001 PKP Pipeline Geotechnical and Contamination Site Investigation Report (Segment 2)

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan

E-003-DAM Dam Construction, Maintenance or Extension

Category: ExternalInterference

Description: Dam construction not credible within the pipeline route - residential/industrial location class, lack of physical space or purpose.

Threat is not credible ●

Physical:

Procedural:

E-004-WAT Water bores installation

Category: ExternalInterference

Description: Not an agricultural location, installation of water bores not considered credible.

Threat is not credible ●

Physical:

Procedural:

E-005-VEH Vehicle contacts buried pipe

Category: ExternalInterference

Description: Activity: Traffic accident, heavy vehicle falls or ploughs into table drain
Threat: Coating or steel damage due to vehicle penetration

External interference controls

Physical: Burial:1200mm minimum within road reserve, except 750mm minimum permitted under table drain invert (but will have protection slabs)
HDD Sections - >>1200mm
Wall Thickness:13.5mm WT
Barrier to Penetration:Concrete or Poly slabs under table drains if cover < 1200mm (open-cut crossings only)

Procedural:

Failure Analysis Not credible that highway vehicle could penetrate 1200 mm cover plus concrete slab, given the soil conditions typical of formed roads

Failure not possible ✓

E-006-DRM Table drain maintenance - road and rail reserves

Category: ExternalInterference

Description: Activity: Table Drain Maintenance
Threat: Coating or steel damage due to tool impact.
Who: Road authority (e.g. council or government authority) or contractor
Equipment: Normal drain maintenance is performed with a light excavator with a flat bucket
Depth: Normal practice is to restore original drain profile, but no further excavation.
When / Frequency: as required

Refer GAS-950-DW-HX-001 (Open cut road/track crossing typical drawing) and GAS-950-DW-HX-003 (Bored road crossing typical drawing).

External interference controls

Physical: Burial:1200mm minimum within road reserve, except 750mm minimum permitted under table drain invert (will have protection slab)
HDD Sections - >>1200mm
Wall Thickness:13.5mm WT can resist penetration for flat bucket >55T
Barrier to Penetration:Concrete slabs under table drains if cover < 1200mm (open-cut crossings only)

Procedural: Signs:As per AS2885. Signs at road crossings.
Marker Tape:Marker tape across full width of road reserve and beyond, except for bored section of bored crossings
Dial Before You Dig:Pipeline in registered on DBYD in NSW
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial

Threat is controlled ✓

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan
45	GAS-950-DW-HX-001	PKLL Pipeline Open Cut Road/Track Crossing Typical Drawing
44	GAS-950-DW-HX-003	PKLL Pipeline Bored Road Crossing (Uncased) Typical Drawing

E-007-RDC Road construction - Northcliffe Dr

Category: ExternalInterference

Description: Activity: Ground penetration (including for piled footings) during future road construction for the extension of Northcliffe Drive
Threat: Coating or steel damage due to tool impact. possible pipe penetration, gas release
Who: Road authority (e.g. council or government authority) or contractor
Equipment: Excavator or truck mounted auger
Depth: TBC
When / Frequency: TBC

Jemena advised of Northcliffe Drive planned extension at KP10.5. Jemena have already been in negotiations with council regarding plans and design/configuration of the bridge which will go across rail and pipeline easement. It is likely that construction works will occur on top of the easement but in consultation with Jemena. The proposed bridge has the potential for piled footings. This would be a major construction activity and would include site investigtion activties such as major geotech investigations (eg. rock core sampling using reverse circulation drilling / coring equipment), service location and a detailed design process.
These are non-routine activities carried out by large, well resourced, competent organisations, and which require significant planning, formal consultation and regulatory approvals. This includes requirements for Jemena to provide input into the design process, approve crossing design and construction plans, and manage construction activities at the time of the project. This is addressed on a case by case basis, and includes Land Use Change and/or Encroachment SMS processes.

All other road crossings are by HDD at significant burial depth.

External interference controls

Physical: Separation by Distance:Piles/footings will be designed so that the is sufficient separation between pipe Wall Thickness:13.5mm WT

Procedural: Signs:As per AS2885.
Marker Tape:Marker tape across full width of road reserve and beyond, except for bored section of bored crossings.
Dial Before You Dig:Pipeline in registered on DBYD in NSW
Landowner Liaison:Regular liaison with Landowners, (refer GAS-599- PA-LM-001 / 002).
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial
Planning Notification Zone:NSW - Online planning notification site for councils. Major project portal for large projects.

Threat is controlled ✓

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan

E-008-RWY Rail locomotive or carriage contacts pipe

Category: ExternalInterference

Description: Activity: Railway accident, loco or wagon falls or ploughs into table drain.
Threat: Coating or steel damage due to vehicle penetration

External interference controls

Physical: Burial:4000mm minimum below top of rail, 1200mm below table drain
Wall Thickness:13.5mm WT

Procedural:

Failure Analysis Refer GAS-599-PH-RM-001, Section 5.3.3.3Experience from examination of train derailment events is that rail vehicle parts tend not to penetrate the ground much further than half a wheel diameter (ie. rail vehicles sink not much further than axle deep). Hence with minimum cover of 1200 mm under table drains, and greater cover elsewhere, it is most unlikely that derailed vehicles could directly impact the pipe.

Failure not possible ✓

References

2	GAS-599-PH-RM-001	EGP Risk Assessment of Common Threats to Standard Designs

E-010-UMA Buried utility maintenance - ABOVE NEW PIPELINE (crossing or parallel)

Category: ExternalInterference

Description: Activity: Buried Utility Maintenance
Threat: Coating or steel damage due to tool impact resulting in dent/gouge requiring repair
Who: Utility owner or contractor
Equipment: Excavators or rubber tyred backhoes, typically in the 5t - 20t range (see below). Excavators up to 30t are credible. Buckets are flat buckets or fitted with GP teeth (tiger teeth are not used because utilities do not want to damage their own assets).
Depth: Buried utilities are above the Pipeline at virtually every location. Protection slabe between new pipeline and third party asset only if the third party asset is >200mm in diameter.
When / Frequency: TBC

Soil up to approx. 4-6m is softer uncontrolled fill/residual soil. Equipment used would be selected for the soil conditions i.e. light equipment, flat buckets. Therefore, contact with pipeline would be a noticeable change in resistance during excvation and equipment used unable to penetrate the pipe.

Refer GAS-599-PH-RM-001, Section 5.7.3.1
The pipeline will in almost all cases be laid below other utilities. The only exception would be exceptionally deep sewers or drains where construction difficulties inhibit deep burial of the pipe. There will be few if any such cases. The fact that the pipe is below other utilities provides a high degree of protection against serious interference. In addition Jemena approval for any excavation within the pipeline easement requires compliance with Jemena procedures. These procedures include requirements for Jemena supervision, identification of pipe position, and restrictions on excavator tool type (in particular excavator buckets must have either no teeth or protective bars fitted).
In the unlikely event that contact is made with the pipe the consequences will be coating damage and possibly steel surface damage. It is barely credible that the pipe could be penetrated (refer Resistance to Penetration calc GAS-556-CA-ME-002).

Refer GAS-599-PH-RM-001, Section 4.3.1
Investigations undertaken with Local governments determined that road maintenance and general municipal construction is typically undertaken with graders, excavators, rollers and trucks with a nominal maximum size/weight of around 15 to 20 t.
Rubber tyred backhoes are commonly used by both local government and small contractors because of their mobility. Catalogue information on backhoes shows that the typical weight is 7-8 t with a maximum of 10 t.
Specialist authorities (rail, road, catchment management) tend to use larger machines, up to an excavator size of 30 t.

External interference controls

Physical: Burial:Cover 600mm minimum separation below utility at crossings
1200mm minimum cover at road crossings
HDD Sections - >>1200mm
Separation by Distance:For parallel services, requirement for slabbing will be determined on a case by case basis depending on separation distance, size of asset and size of excavation and service type.
Wall Thickness:13.5mm WT can resist penetration from excavation equipment used.
Barrier to Penetration:Foreign utility crossings: Pipeline typically crosses under foreign utilities. Concrete slabs are placed a minimum of 300mm above the top of pipe, below the other service (refer GAS-950-DW-UX-001).

Procedural: Signs:As per AS2885. Signs at road crossings.
Marker Tape:At open cut road crossings
Dial Before You Dig:Pipeline in registered on DBYD in NSW
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial

Threat is controlled ✓

References

24	GAS-556-CA-ME-002	Resistance to Penetration Calculation
15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan
2	GAS-599-PH-RM-001	EGP Risk Assessment of Common Threats to Standard Designs
43	GAS-950-DW-UX-001	PKLL Pipeline Buried Utility Crossing Open Cut Type Typical Drawing

E-011-UMB Buried utility maintenance - BELOW NEW PIPELINE (crossing or parallel)

Category: ExternalInterference

Description: Activity: Buried Utility Maintenance
Threat: Coating or steel damage due to tool impact resulting in dent/gouge requiring repair
Who: Utility owner or contractor
Equipment: Excavators or rubber tyred backhoes, typically in the 5t - 20t range (see below).
Excavators up to 30t are credible. Buckets are flat buckets or fitted with GP teeth (tiger teeth are not used because utilities do not want to damage their own assets).
Depth:
When / Frequency: TBC

Applies at KP8.4 at crossing of existing PKL Pipeline adjacent temple footbridge.
Location specific design for the crossing at KP8.4 is documented on drawing GAS-556-DW-UX-001.
Concrete protection slabs will be provided above the new PKP pipeline at this location due to reduced DOC.

This threat also applies at number of locations where existing services are at significant depth, including: KGMS where new PKP crosses the existing EGP, graincorp underground conveyor within PKCT (KP1.65).

External interference controls

Physical: Wall Thickness:13.5mm WT can resist penetration from excavation equipment used.
Barrier to Penetration:Where the PKP crosses on top of another service, slabs to be installed regardless of depth of cover.

Procedural: Signs:As per AS2885, and intervisible.
Marker Tape:All trenched sections will have marker tape.
Dial Before You Dig:Pipeline to be registered on DBYD in NSW.
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599-PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS).
Activity Agreements:Crossing agreements with owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; weekly aerial

Threat is controlled ✓

Actions

2021-DD-009	Location Specific Crossing Drawings	Closed

References

60	GAS-556-DW-UX-001	Port Kembla Lateral Crossing Detail (Near Temple Foot Bridge)
15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)

E-012-CBL Comms Cable Installation - Cable Plough

Category: ExternalInterference

Description: Not credible for the land use in this area. Installation of comms cables would either be by excavator or HDD.

Threat is not credible

Physical:

Procedural:

E-013-HDD Minor Utility installation - HDD

Category: ExternalInterference

Description: Activity: HDD for installation of utilities in T1 Location
Threat: Coating or steel damage due to tool impact - typically a gouge if operating normally.
Who: Utility company (e.g. Comms - Telstra or Optus; Water; Electricty, Gas) or contractor.
Equipment: Micro HDD (e.g. Vermeer D10), Mini HDD (e.g. Vermeer D24), fitted with angled drill bits (e.g. square or tapered sand pits, bear claw bits etc) for drilling through sand, clay, gravel etc).
Depth: Typically in the range 600mm to 900mm. In built-up urban areas, HDD is also used to cross under multiple buried assets (typically at a road crossing), in which case the HDD is planned to cross these assets well below them (i.e. a few metres below).
Where: Typically in road reserves. Port Kembla Pipeline is most under threat where it crosses a road and the utility is being installed in the road reserve, parallel to the road. However, in these cases utilities are usually installed using light trenching equipment (e.g. small dithcwitch, light excavator), and HDDs are only used to cross under infrastructure such as roads, driveways and other buried utilities (e.g. the EGP).

Note: In Jemena's experience, HDD activities are well-planned and well-coordinated, and very well controlled. Jemena are advised by DBYD processes. Jemena have not experienced any issues or incidents with HDD projects.

Refer GAS-599-PH-RM-001, Section 5.7.3.3
Horizontal Directional Drilling (HDD) is becoming an increasingly popular method for installing various buried utilities. The risk posed to the pipeline by HDD is unique as the above-ground equipment can be quite distant from the pipe, and thus regular right-of-way patrolling may not pick up the threat. It is quite feasible that the directional drill can penetrate the pipe, although the probability is remote (refer to failure analysis discussion). Jemena will place particular emphasis on liaising with as many HDD contractors as possible. This may include contacting any existing industry associations for HDD and raising general awareness of the risks to the pipeline.

External interference controls

Physical: Burial:For minor utilities installed in road reserves, utility installation depth is typically 600 mm to 900mm. The minimum depth of cover on this pipeline is 1,200mm.
Separation by Distance:Where HDD's are designed and installed to avoid a number of buried utilities, they are planned to be installed a minimum 1m depth below the pipeline.
Wall Thickness:Standard wall (13.5mm WT). Based on EPCRC research to date, wall thickness is expected to provide resistance to penetration for light equipment and types of bits used.

Procedural: Signs:As per AS2885. Signs at road crossings.
Dial Before You Dig:Pipeline is registered on DBYD in NSW
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial
Other:In Jemena's experience, HDD activities are well planned, coordinated and controlled.

Threat is controlled ✓

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan
2	GAS-599-PH-RM-001	EGP Risk Assessment of Common Threats to Standard Designs

E-014-SEW Deep sewer or stormwater drain install

Category: ExternalInterference

Description: e.g. installation of deep sewer or stormwater pipelines associated with new residential developments (particularly in outer sydney area)

Not credible - 1) pipeline route in developed area with established services; 2) Pipeline is not located in areas zoned for residential development, (i.e. generally public land, road reserves, etc).

Threat is not credible

Physical:

Procedural:

E-015-PPR Power pole replace or duplicate

Category: ExternalInterference

Description: Activity: Power pole installation (replacement or duplication) using auger
Threat: Coating or steel damage due to tool impact, possible pipe penetration with auger (<50mm hole size)
Who: Utility owner or contractor
Equipment: Proline Auger or excavator-mounted pendulum auger (typically 5t to 10t). Increasingly, vac trucks are used for powerpole operations, particularly in urban areas with soft soils.
Depth: Typically 2-3m
When / Frequency: TBC

This threat is greatest where the poles of a power line are close to the pipeline, since replacement poles are likely to be adjacent to existing poles. If a power line is reconstructed or duplicated then the new poles may not correspond to existing pole positions.

Locations where power poles have been identified in close proximity to the new pipeline.
Port Kembla Pipeline -
Segment 1:
1)KP4.3 to KP5.0 - Pipeline is in same easement as above ground powerlines and parallel to transmission poles.
Segment 2:
1) Waynote Pl to Lathe Pl - Trenched Section - KP0.57 to KP1.07 - Pipeline in easement is parallel to power poles and also crossed by a number of HV transmission lines.
2) Berkely Street Substation area - trenched alignment is relatively close to major powerlines / poles.
3) End of Wyllie Road (KP4.7 to KP4.8) - two power poles located between exiting Port Kembla Lateral Pipeline alignment and proposed Port Kembla Lateral Looping Pipeline

Geotechnical investigation of the pipe route indicated soils up to approx. 4-6m is softer uncontrolled fill/residual soil. Equipment used for excavation/drilling would be selected for the softer soil conditions. Therefore, contact with pipeline would be noticeable and equipment used would be unable to penetrate the pipe (min 13.5 mm WT).

Additionally, Jemena will review proximity to power poles and include concrete/hdpe protection slabs on a case by case basis.

External interference controls

Physical: Burial:for HDD sections, DoC >>1200 (generally >5000mm)
Separation by Distance:In general, poles are sufficiently distant from the pipeline (i.e. >5m) so that separation by distance is a control.
Wall Thickness:Standard wall thickness (13.5mm WT) is sufficient to provide protection
Barrier to Penetration:Detailed Design SMS Comment from MP: If a power pole is in the near vicinity of the pipeline, an assessment will be made on a case by case basis as to whether a slab is required to be installed to protect the pipeline.

Procedural: Signs:As per AS2885. Signs at road crossings. As a further measure, a pipeline warning sign is placed directly under every power line crossing.
Marker Tape:For trenched sections only.
Dial Before You Dig:Pipeline in registered on DBYD in NSW
Landowner Liaison:Regular liaison with Landowners, (refer GAS-599- PA-LM-001 / 002).
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Easement agreements with each landowner, which restrict the activities permitted within the easement.
Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial

Threat is controlled ✓

Actions

2021-FEED-002	Pipeline casing/slab adjacent power poles within close proximity of pipeline	Closed

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan
2	GAS-599-PH-RM-001	EGP Risk Assessment of Common Threats to Standard Designs

E-017-PPI Power pole installation (new powerlines or services)

Category: ExternalInterference

Description: Activity: Installation of new powerline (e.g. to development, property or facility).
Threat: Coating or steel damage due to tool impact, possible pipe penetration with auger (<50mm hole size) (TBC)
Who: Utility owner or contractor
Equipment: Proline Auger or excavator-mounted pendulum auger (typically 5t to 10t). Truck mounted auger. Increasingly, vac trucks are used for powerpole operations, particularly in urban areas with soft soils.
Depth: Typically 2-3m
When / Frequency: TBC

Power pole earthing also requires additional excvation via auger to a depth equal or greater than the pole footing.
Soil up to approx. 4-6m is softer uncontrolled fill/residual soil. Equipment used would be selected for the soil conditions i.e. light equipment, soft soil auger heads. Therefore, contact with pipeline would be a noticeable change in resistance during excvation and equipment used unable to penetrate the pipe.
Planned activitiy with consultation with power authority.

External interference controls

Physical: Wall Thickness:Standard wall (13.5mm WT) in normal trench, under road pavement, table drains and any anticipated road widening. Wall thickness is sufficient to provide protection in most cases for light equipment.

Procedural: Signs:As per AS2885. Signs at road crossings.
Marker Tape:For trenched sections only
Dial Before You Dig:Pipeline in registered on DBYD in NSW
Landowner Liaison:Regular liaison with Landowners, (refer GAS-599- PA-LM-001 / 002).
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Easement agreements with each landowner, which restrict the activities permitted within the easement.
Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial

Failure Analysis Geotechnical investigation of the pipe route indicated soils up to approx. 4-6m is softer uncontrolled fill/residual soil. Equipment used for excavation/drilling would be selected for the softer soil conditions. Therefore, contact with pipeline would be noticeable and equipment used would be unable to penetrate the pipe (min 13.5 mm WT).

Failure not possible ✓

E-018-AGR Agricultural activities - shallow

Category: ExternalInterference

Description: Agricultural activities not credible within the residential/industrial location class followed by the alignment. No farms or agricultural areas visible within the measurement length.

Threat is not credible 

Physical:

Procedural:

E-021-VEX Facilities - Vehicle impact (external)

Category: ExternalInterference

Description: Activity - Vehicle impact (uncontrolled vehicle external to facility) - in this case threats are uncontrolled vehicles in Wyllie Road (60 kph) or recreational vehicles (e.g. 4WD) utilising vacant land (ex-slag dump site) to the east of the proposed facility. (remove->?) This land is elevated above the facility and Wyllie Road.
At PKGT, the threat is impact form a vehicle within AIE's allotment.

Threat - Impact. Pipe distortion, instrument and control equipment damage, possible loss of integrity.

External interference controls

Physical: Barrier:Armco railing installed at top of hill above eastern boundary of facility to prevent recreational vehicles (4WD) from falling onto facility.

Bollards provided along roadside at PKGT.
Separation by Distance:Kembla Grange Meter Station is built up above the road level with a stormwater earthen swale between the road and the station. Road is 60kph speed limit - uncontrolled vehicle cannot reach station.
Wall Thickness:Station pipework at least STD wall (~10mm).

Procedural:

Failure Analysis There are no procedural controls. However the physical controls listed are such that failure is not possible.Based on existing Wylie Rd (before Northcliffe Dr Extension): KGMS is built up above the road level for drainage and flood management. There is an earthern drain/swale between the road and the station which any car that has left the road would more likely come to a stop in. The road near the KGMS is 60km/h speed limit. The station is on the inside of a bend; vehicle more likely to leave the road from the outside of the bend.The planned Northfliffe Dr extension/road upgrade will increase the width of Wylie Rd, reducing separation between road edge and facility, and will change the intersection from a bend to a 4-way intersection. However, there will still be a drainage swale between the road and the station, and the station is built up by 1m above the road level. An action has been allocated to confirm whether an armco barrier should be installed on the Wylie Rd side of KGMS facility.PKGT is protected by bollards. Vehicles are low speed within the PKCT and within access is restricted to approved personnel within AIE allotment.

Failure not possible ✓

Actions

2021-FEED-001	Extend existing armco railing east of KGMS	Closed
2021-DD-007	Vehicle Impact KGMS Facility	Closed

E-022-VIN Facilities - Vehicle (or dropped object) Impacts to Above-Ground Piping

Category: ExternalInterference

Description: Activity - Vehicle impact (Jemena maintenance vehicles operating inside a facility) or dropped objects from cranage activities.
Threat - Impact to above-ground pipe work. Pipe distortion, instrument and control equipment damage, possible loss of integrity.

External interference controls

Physical: Barrier:Bollards to be installed around above ground piping at both KGMS and PKGT for piping exposed to internal vehicle roadways.
Wall Thickness:Standard wall pipe for above ground pipng (WT ~10mm) sufficient to resist vehicle impact. Small bore piping is vulnerable.

Procedural: Signs:Above ground piping is visible to maintenance personnel.
Other:Jemena Procedures
- Vehicle access is limited to maintenance activities subject to permit to work requirements
- All crane lifts are classed as critical lifts subject to lifting plans
- Trained and experienced personel operating to procedures

Threat is controlled ✓

E-023-BLS Blasting

Category: ExternalInterference

Description: NOT Credible - no mining or other blasting sites identified - Residential / Industrial location

Threat is not credible ●

Physical:

Procedural:

References

18	GAS-960-GL-PL-001	Guideline to designing constructing and operating around existing AS2885 natural gas pipelines

E-024-EAR Earthworks associated with new showroom at 9-11 Waynote Pl, Unanderra

Category: ExternalInterference

Description: Activity: Earthworks for industrial/showroom development including cut and fill of sloping site with rock wall to western alignment.
Threat: Coating or steel damage due to tool impact resulting in dent/gouge requiring repair, penetration
Who: Contractor (working for Charta Developments)
Equipment: Excavator (50t with rock breaking pick attachments), Excavator (30t), Mine specification dump truck/haulers (unknown weight).
Depth: (TBC)
When / Frequency: (TBC)

Threat will not be credible when pipeline is installed - the development will completed before the pipeline construction commences.

Threat is not credible ●

Physical:

Procedural:

E-025-LMA Vegetation and land maintenance

Category: ExternalInterference

Description: Activity: Shallow land management activities including mowing grasses, installation/maintenance of irrigation lines, trim vegetation in fields traversed by pipeline.
Threat: Impact by ploughing or trenching equipment resulting in a dent/gouge and/or coating damage requiring repair.
Who: Council, contractor
Equipment: Ride-on mower, small excavator or hackhoe (<10t); small trenching machine
Depth: Activities to a depth <500mm (typically 200mm - 300mm)
When / Frequency: Monthly

External interference controls

Physical: Burial:Pipeline min. depth of cover 1200mm
Wall Thickness:13.5mm WT can resist penetration by light equipment

Procedural: Signs:As per AS2885. Signs to be intervisible.
Marker Tape:For trenched sections only
Landowner Liaison:Regular liaison with landowners, (refer GAS-599-PA-LM-001 / 002)
Activity Agreements:Easement agreements with each landowner, which can restrict the activities permitted within the easement.
Patrolling:Limited effectiveness for this threat.
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Annual ground patrol, weekly road patrol, weekly aerial patrol.

Threat is controlled ✓

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan

E-026-HDD Major Utility Installation - HDD

Category: ExternalInterference

Description: Activity: HDD for installation of major (>DN200) utilities in T1 Location
Threat: Coating or steel damage due to tool impact
Who: Utility company (e.g. Comms - Telstra or Optus; Water; Electricty, Gas) or contractor.
Equipment: Midi-HDD (Vermeer D100) or Maxi-HDD (e.g Vermeer D330)
Depth: Up to 15m
Where: Most likely watercourse crossings, i.e. Gurungaty Waterway and Allans Creek.

Major construction project may include installation of water or gas pipelines using large HDD equipment or thrust bores, etc. These projects include site investigation activities such as major geotech investigations (e.g. rock core sampling using reverse circulation drilling / coring equipment). The equipment used for these projects can be heavier and have greater potential to penetrate the pipeline than that in use for general activities.

These are non-routine activities carried out by large, well resourced, competent organisations, and which require significant planning, formal consultation and regulatory approvals. This includes requirements for Jemena to provide input into the design process, approve crossing design and construction plans, and manage construction activities at the time of the projects. This is addressed on a case-by-case basis, and includes Land Use Change and/or Encroachment SMS processes. In these cases, physical controls to protect the pipeline are specified on the basis of the details of the project design, and planned construction equipment and construction techniques.

External interference controls

Physical: Separation by Distance:Separation by distance (e.g. design of HDD bore to avoid the PKP; design of geotech program to avoid PKP) may be mandated (i.e. on a case by case basis) by Jemena as the result of the requirement for Jemena to provide input into the design process, approve crossing design and construction plans, and manage construction activities.
Wall Thickness:13.5mm wall thickness is expected to provide resistance to penetration in most cases.

Procedural: Signs:As per AS2885. Signs at road crossings.
Dial Before You Dig:Pipeline is registered on DBYD in NSW
Landowner Liaison:Regular liaison with Landowners, (refer GAS-599- PA-LM-001 / 002). Liaison encourages landowners to use DBYD.
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Limited effectiveness for this threat
Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial
Planning Notification Zone:NSW - Online planning notification site for councils. Major project portal for large projects.
Other:In Jemena's experience, HDD activities are well planned, coordinated and controlled.
These are non-routine activities carried out by large, well resourced, competent organisations, and which require significant planning, formal consultation and regulatory approvals. This includes requirements for Jemena to provide input into the design process, approve crossing design and construction plans, and manage construction activities at the time of the projects. This is addressed on a case by case basis, and includes Land Use Change and/or Encroachment SMS processes.

Threat is controlled ✓

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan

E-027-TNK Proposed tank farm development at land parcel DP1125445 (KP1.3)

Category: ExternalInterference

Description: Activity: Future installation of storage tank farm in close proximity to the pipeline.
Threat: Coating or steel damage due to tool impact
Who:
Equipment:
Depth: Up to 5m
Where: Between KP1.3 and KP1.4

The pipeline alignment has considered separation to the proposed tanks.

External interference controls

Physical: Burial:HDD pit just before the proposed tanks location. Depth of pipe adjacent tanks is approx. 5m
Separation by Distance:The pipeline alignment has considered a 5m (approx.) offset from the extent of the tank footings.
Wall Thickness:Wall thickness fo 13.5mm provides resistance to penetration to all credible excavator sizes (up to 55T).

Procedural: Signs:One sign at either end of the HDD and one sign at the location where the HDD depth reaches 5m, and in accordance with requirements of AS2885.1.
Marker Tape:Marker tape to be installed for trenched sections.
Dial Before You Dig:Pipeline will be registered on DBYD in NSW
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Planning Notification Zone:NSW - Online planning notification site for councils. Major project portal for large projects.

Threat is controlled ✓

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)
16	GAS-599-PA-IN-002	EGP Pipeline Integrity Management Plan

E-028-UTL Angled trenched pipeline immediately downstream of HDD-01 in PKCT

Category: ExternalInterference

Description: Activity: Installation of a buried service in parallel to the PKP along PKCT Road 1.
Threat: Coating or steel damage due to tool impact
Who: PKCT, Utility Owner
Equipment: Excavator up to 30t, fitted with GP or Tiger Teeth, but typically 10-12T with a flat bucket.
Depth: 600-1500mm
Where: approx. KP0.55

Any service installed in this road in the future will likely cross the new PKP pipeline where it crosses from the verge to the road diagonally.

Protection slabs to be installed for this diagonal section.

External interference controls

Physical: Wall Thickness:13.5mm wall thickness is expected to provide resistance to penetration in most cases.
Barrier to Penetration:Concrete or HDPE slabs to be installed across the section of line that crosses from verge to road.

Procedural: Signs:As per AS2885
Marker Tape:Marker tape will be installed above all trenched sections
Dial Before You Dig:Pipeline to be registered on DBYD in NSW Dial Before You Dig effective in reduction of likelihood
Third Party Liasion:Regular liaison with local governments, utilities and other relevant bodies (refer GAS-599- PA-LM-001 / 002). Provision of pipeline location information to local governments, utilities, etc (where possible in GIS format for inclusion in the authority's GIS)
Activity Agreements:Crossing agreements with the owners or authorities responsible for roads, railways and services, which control the activities permitted by each party at the pipeline crossing.
Patrolling:Patrolling as per EGP PIMP GAS-599-PA-IN-002
Existing Port Kembla Lateral - Annual Ground Patrol; Weekly road patrol; Weekly Aerial
Planning Notification Zone:The location is within the PKCT which is managed by NSW Ports and any works would require approval by the port authority and trigger a planning notification to Jemena
Other:This section is located in PKCT which is not accessible to public. Any access and works in the PKCT requires approval incl. planning (identifying buried services), DBYD process, competent contractor etc.

Threat is controlled ✓

Actions

2021-DD-008	Physical Protection Requirement within Common Service Corridors	Closed

References

15	GAS-599- PA-LM-001 / 002	EGP Landholder Engagement Plan (001-NSW, 002 Victoria)

E-029-BLU Utility installation in Bluescope land between KP4.3 and KP5

Category: ExternalInterference

Description: Activity: Installation of a buried service in parallel to the PKP between KP4.3 and KP5 (land owned by Bluescope and contains existing overhead power lines)
Threat: Coating or steel damage due to tool impact
Who: Bluescope, Utility Owner
Equipment: Unknown
Depth: Unknown
Where: KP4.3 to KP5

In discussion for Bluescope easement for the PKP between KP4.3 and KP5 to date there has been no indication of plans to install any other powerlines in this corridor. It is also noted that this corridor is highly controlled by Bluescope (i.e. new pipeline or other utility consruction threat in this corridor is not credible, without detailed planning and control by Bluescope).

Threat is not credible ●

Physical:

Procedural:

E-030-PKGT External Interference During Construction at PKGT

Category: ExternalInterference

Description: Threat is construction at the Port Kembla Gas Terminal required for reconfiguration of the wharf to accommodate the FSRU including mooring dolphins and tie-rods pose an external interference threat to the pipeline.

Threat is Not Credible as Construction sequencing is such that the civil bulk earthworks (tie-rods, mooring dolphins) will be complete prior to the pipeline installation.

Threat is not credible 

Physical:

Procedural:

I-001-INT Facilities - Vandalism

Category: IntentionalDamage

Description: Activity - unauthorised access
Threat - Vandalism, instrument / control system damage / instrument tube damage and gas release

Control by design and/or procedures

Security arrangements are determined by security assessments documented in GTS-599-RP-RM-001 EGP Security Assessment, and GTS-599-RP-RM-013 EGP Expansion Security Assessment.
Access by gates and site access is monitored continuously and alarms raised in GTCR for most sites.
Response by Operator / Police.
Operating procedure will monitor unauthorised entry and will if needed provide increase patrolling and site security if anticipated.

A site specific security assessment process has been completed for the new facilities at KGMS and (Out of Scope) Cringila Lateral Inlet Facility; refer document number GAS-557-RP-RM-001.

Threat is controlled ✓

Actions

2021-DD-015	PKGT Security Risk Assessment	Open

References

92	GAS-557-RP-RM-001	EGP Kembla Grange Main Line Valve Security Risk Assessment (Incorporating Project Marlin Upgrade)
19	GAS-599-RP-RM-001	EGP Security Assessment
20	GAS-599-RP-RM-013	EGP Expansion Security Assessment

I-002-TER Terrorism

Category: IntentionalDamage

Description: Terrorist attack on the buried pipeline to cause commercial and economical damage to affect the general operation of the community - results in failure

Control by design and/or procedures

Security arrangements are determined by security assessments documented in GTS-599-RP-RM-001 EGP Security Assessment, and GTS-599-RP-RM-013 EGP Expansion Security Assessment.
Terrorism threats are addressed by Jemena corporate processes and risk assessment - Crisis Emergency and Security Systems Manager responsible for ongoing assessment of risk.

A site specific security assessment process has been completed for the new facilities at KGMS and (Out of Scope) Cringila Lateral Inlet Facility; refer document number GAS-557-RP-RM-001.

Threat is controlled ✓

References

92	GAS-557-RP-RM-001	EGP Kembla Grange Main Line Valve Security Risk Assessment (Incorporating Project Marlin Upgrade)
19	GAS-599-RP-RM-001	EGP Security Assessment
20	GAS-599-RP-RM-013	EGP Expansion Security Assessment

I-003-CYB Cyber threats

Category: IntentionalDamage

Description: Attack on Jemena's digital systems, to remotely control facilities - either to shut-off supply or change pressure set points at compressor stations so that pipeline can be overpressured.

Control by design and/or procedures

Jemena IT security policy and procedures.
Secondary pressure protection (relief valves) at compressor stations will protect downstream pipework in the event of failure of pressure control systems.
SCADA surveillance / alarms.
Known risk assessed through JCARS system.

A site specific security assessment process has been completed for the new facilities at KGMS and (Out of Scope) Cringila Lateral Inlet Facility; refer document number GAS-557-RP-RM-001.
This security assessment considers disgruntled employees.

Threat is controlled ✓

References

92	GAS-557-RP-RM-001	EGP Kembla Grange Main Line Valve Security Risk Assessment (Incorporating Project Marlin Upgrade)

N-001-PEA Peat Fires

Category: NaturalEvents

Description: Acid sulfate soils have been identified at the Cringila end of the pipeline near HDD-01 eastern pit. No organic matter has been identified in the soil samples, however, the geotechnical works are not final. As per Action 7, the risk of Peat fire will not be discounted as non-credible.

During January 2020, there was a peat fire near KP82 on the EGP mainline. Peat fire is a slow, low temperature, persistent fire that burns beneath the surface. Refer GAS-599-RP-IN-012 Section 3.3.1. Refer GAS-599-RP-IN-012 Section 3.3.1.
In order to mitigate against the threat of the peat fire approaching the pipeline and causing coating and pipe wall damage, the following conservative actions were undertaken:
- EGP pressure was reduced to ~10MPa at KP82, this is to account for any reduction in yield strength due to pipe wall temperature increase in the event that the peat fire was not controlled and reached the EGP
- Soil temperatures near the pipeline at the pipeline's depth was taken to ensure that the peat fire was not causing elevated temperatures near the pipeline (refer Refer GAS-599-RP-IN-012 APPENDIX A – Peat Fire)
- Country Fire Authority (CFA) used drones with thermal imaging capability to measure the ground temperature, which was found to be max of 350 deg C.
- As a precaution, HYSYS modelling was undertaken to determine the cooling effect of theflowing gas in the unlikely event that the peat fire was uncontrolled and directly impacted the EGP. The HYSYS modelling (refer APPENDIX A – Peat Fire) identified that the pipe wall
temperature based on this very conservative model (peat fire temperature was also assumed to be 800 deg C, research suggests that Peat fire maximum temperatures are less than 600 deg C) wouldn't exceed 50 deg C.
- CFA constructed trenches parallel to the EGP and filled it with water to provide a barrier in the event that the peat fire was not contained The peat fire was bought under control by the CFA before it could cause any noticeable increase in ground temperature anywhere near the pipeline.

While this incident didn't cause any integrity issue to the pipeline it highlighted peat fires as a potential threat to the integrity of the pipeline. Risk register IDP6704 was raised to cover off on this location specific threat, and was closed out after the peat fire was contained.

Control by design and/or procedures

With reference to GAS-599-RP-IN-012 Section 5.6, a desktop safety management study of the threat/s posed by peatlands in the vicinity of EGP was undertaken in October 2020 and is documented in Peat Fire SMS-Rev 0.
It should be noted that peat is an organic soil and many organic soils are potential acid sulphate soils. The locations of the acid sulphate soils on the EGP are currently available on GIS as a specific layer. In general, there are 5 areas of acid sulphate soils along the EGP, all located in Gippsland in Victoria. It should be noted that the presence of acid sulphate soil doesn't always correlate to peatlands, however the chances are higher.
Jemena have also obtained available data from Satellite remote sensing technology which can determine carbon % of soil down to 2m depth below ground. These maps are included in GAS-599-RP-IN-012 Appendix B – Potential Peatlands.
In the unlikely event that another peat fire incident occurs in the vicinity of the EGP, the actions that were undertaken to mitigate the threat in Q1 2020 will be used as a template to manage the threat.
These actions include but are not limited to:
- Where the peat fire is not able to be controlled, consider reduction in pressure to offset an expected yield strength de-rating due to increased pipe wall temperature
- Where safe to do so, install ground temperature monitoring probes near the pipeline at a similar depth to the pipeline to monitor any soil temperature increase due to the peat fire
- Build a barrier between the peat fire and the pipeline, this is likely to be a trench built parallel to the pipeline and where possible filled with water
- Actions by firefighting authorities, such as trenching and/or application of water.
- Aerial thermal imaging cameras to determine hot spots in the area

It is further noted that the worst case scenario occurs when there is negligible flow in the pipeline, which reduced the cooling effect of the gas flowing in the pipeline. However, this is not a foreseen scenario, given that the EGP provides critical gas supply to the NSW market. Notwithstanding this, in case of the negligible flow scenario in the EGP, Jemena will implement the same mitigation measures that were implemented during the 2020 incident and take into consideration that the negligible flow case won't have the benefit of gas cooling effect and therefore, pressure reduction may be required to account for pipe wall temperature increase and any loss of yield strength.

The above controls are considered effective in controlling the threat.

Threat is controlled ✓

Actions

2021-FEED-007	Confirm whether peat fire is a credible risk	Closed

References

3	GAS-599-RP-IN-012	EGP Integrity Report - External Interference and Pipeline Route
11	Peat Fire SMS-Rev 0.xlsx	Peat Fire SMS

N-002-FLO Minor erosion at water course

Category: NaturalEvents

Description: There is a minor wetlands area around KP4.18 (Segment 2) - this is crossed by open trench.

Activity: Minor erosion leading to reduced cover
Threat: Flotation of pipe resulting in exceeding stress limits and causing ovality/dents/buckling

Control by design and/or procedures

Buoyancy calculation has been completed for wetland and any risk to pipeline integrity will be managed accordingly by the design - refer calculation GAS-556-CA-PL-009. The pipeline will resist flotation with as little as 300mm cover.

Segment 1 water course crossings are installed by HDD.

Threat is controlled ✓

Actions

2021-FEED-004	Buoyancy at wetland crossing	Closed

References

68	GAS-556-CA-PL-009	Pipeline Buoyancy Calculation

N-005-FIR Fire - buried pipeline

Category: NaturalEvents

Description: Activity - bushfire or controlled fire to burn forest debris in logging areas.
Threat - coating degradation due to high temperature

Refer GAS-599-PH-RM-001, Section 5.10.3.2
Burning of waste material could conceivably elevate the ground temperature to a point where coating degradation could occur if a burn pile was located directly over the pipeline. Soil cover will provide insulation, and a threat would be posed only by a large pile of debris which burned for some time. Normal liaison practices are adequate to minimise this threat. In the event that it did occur it is readily identified by routine aerial patrols.

Control by design and/or procedures

Depth of cover provides protection from radiant heat and insulates the pipeline from elevated surface soil temperatures. Flowing gas has a cooling effect on steel / coating.

T1/T2 - 1200mm
Road - 1200mm
Rail - 4000mm below rail
HDD - >>1200mm

Threat is controlled ✓

References

2 GAS-599-PH-RM-001 EGP Risk Assessment of Common Threats to Standard Designs

N-006-XFR Facilities - External fire (except major bushfire)

Category: NaturalEvents

Description: Activity - External fire (except major bushfire) - facilities
Threat - Heat exposure, ignition of leaks, damage to control equipment & instrumentation

Control by design and/or procedures

The land around the facilities shows no significant built up vegetation.
The facility compounds are cleared of vegetation
No trees nearby that could fall in facility
Gravelled surface within compounds is non combustible,
Maintenance to control grass, weed growth external to fence (5m around perimeter)

Threat is controlled ✓

N-007-BFR Facilities - Major bushfire

Category: NaturalEvents

Description: Activity - Major bushfire - facilities
Threat - Heat exposure, ignition of leaks, damage to control equipment & instrumentation

Control by design and/or procedures

Vegetation clearance for new KGMS and (Out of Scope) Cringila Lateral Inlet Facility to be in accordance with the existing Kembla Grange MLV Facility requirements.
No vegetation identified around PKGT ORF.

GTS-599-RP-EV-009 EGP Facility Bushfire Study undertook a review of the facilities on the EGP using the Jemena Facility Natural Disaster Design Guideline to determine if any vegetation clearing was required to ensure that the risk from a potential bushfire is acceptable.
The study recommended vegetation clearing at Oallen, Nowra and Port Kembla facilities to ensure there was sufficient buffer distance to provide protection from bushfires.
Below is the status of the actions for the aforementioned facilities:
Oallen: trees were removed across the top of the embankment on the north side of the station.
Nowra: area cleared around the station out to 20m.
Port Kembla: existing vegetation clearance is adequate.

Threat is controlled ✓

References

3	GAS-599-RP-IN-012	EGP Integrity Report - External Interference and Pipeline Route
17	GTS-599-RP-EV-009	EGP Facility Bushfire Study

N-008-CFR Facilities - Control hut fire

Category: NaturalEvents

Description: Activity - fire in control hut
Threat - Nil. Control of MLV and access to data might be lost until repairs affected. Possible data loss, Cathodic protection unserviceable

Control by design and/or procedures

Control huts are located outside of piping HA.
Fire extinguishers at each site.
Smoke detector installed, and remotely monitored at major sites.
Short duration loss of CP unlikely to have any measurable impact on pipeline corrosion.
Site can be attended if required to provided communication and control.

Threat is controlled ✓

N-009-GRS Facilities - Ground settlement

Category: NaturalEvents

Description: Activity - Ground settlement affecting pipework
Threat - Excess stress causing dent/ovality/buckling requiring pipe repair

Control by design and/or procedures

Refer GAS-599-DG-DN-001, Section 3
A detailed geotechnical investigation has been undertaken by Golder Associates; details are provided in Geotechnical and Site Contamination Investigation Report (Interim Report) document no. GAS-556-RP-GI-001.

Geotechnical conditions and requirements have been incorporated into the civil design. ***add reference once known

1) Pipe work, valves and equipment installed on engineered foundations.
2) Maintenance procedures to periodically inspect site – monthly station checks

Threat is controlled ✓

References

39	GAS-556-RP-GI-001	PKP Pipeline Geotechnical and Contamination Site Investigation Report (Segment 2)
29	GAS-599-DG-DN-001	Project Marlin: EGP Reversal Facilities Design Basis Manual

N-010-TRE Facilities - Tree fall

Category: NaturalEvents

Description: No trees around the facility.

Activity - Adjacent trees fall on above ground facilities
Threat - Impact, damage to instruments and instrument tube damage, pipe distortion and possible loss of integrity

Threat is not credible •

N-011-FLD Facilities - flooding

Category: NaturalEvents

Description: Facility is outside of known flood zones.
Facility is built up above ground level and drainage will be considered in the civil design.

Activity - flood
Threat - indundation or flood water / debris damaging equipment

Threat is not credible

N-012-EQU Earthquake

Category: NaturalEvents

Description: Earthquake leading to pipe damage/rupture and loss of containment.

Control by design and/or procedures

Above ground facilities stress analysis has been assessed for earthquake loading scenario. Input loads calculated in accordance with AS1170.4: Structural Design Actions.

No fault lines identified in the geotechnical report GAS-556-RP-GI-001. No specific design for fault lines has been included in the pipeline design.

Refer GAS-599-DG-DN-001, Section 5
Buildings, structures, and fixings shall be designed to resist the earthquake actions specified in AS/NZS 1170.4. Seismic Zone (refer to AS 1170.4 for terminology), as per site locations.

Threat is controlled ✓

References

90	AS/NZS 1170.4	Structural design actions - Earthquake actions
39	GAS-556-RP-GI-001	PKP Pipeline Geotechnical and Contamination Site Investigation Report (Segment 2)
29	GAS-599-DG-DN-001	Project Marlin: EGP Reversal Facilities Design Basis Manual

N-013-GRD Ground Movement - landslip, mine subsidence, etc

Category: NaturalEvents

Description: Not Credible - no known areas or land instability or mining subsidence along the route.
Existing pipeline that the new line parallels has no known history of land slip/subsidence.
Refer Geotech report GAS-556-RP-GI-001.

Threat is not credible ●

References

23 GAS-556-DG-DN-001 Port Kembla Pipeline Design Basis Manual

N-014-LTG Lightning strike

Category: NaturalEvents

Description: Lightning strike on above ground facility that is connected to the pipeline - results in current leaving through pipe wall which results in pin hole, metal loss, or damage to TR units.

Control by design and/or procedures

There are currently no known mitigation for protection of pipe itself against lightning damage. - Jemena (QGP) has experienced damage due to lightning strike in the past. There are no controls to prevent this. Managed by emergency response procedures. These may be detected by one of the following:
- ILI
- DCVG for unpiggable sections
- Patrols
- Landholder liaison
- Station piping is earthed, fencing is earthed.

Lightning protection assessment for facilities.** Not yet Completed**

Wall thickness is sufficient control for pin hole.

Failure Analysis Worst case is a pinhole with a very small radition zone.The APGA Pipeline Operators Group (POG) Incident Database records four instances of pinhole leaks caused by lightning strikes in Australia (discussion of which can be found on the Pipelines Oz website (http://pipelinesoz.wordpress.com/)). These incidents occurred in remote locations in the Northern Territory, Queensland and outback NSW. Jemena (QGP) has experienced damage due to lightning strike in the past.. There are no known design controls that can be implemented. Photographs of one of the incidents shows a large crater blown out by a gas release from a hole ~1.6 mm in diameter. If such an event occurred on the QGP, (i.e. pinhole leak) it would eventually be detected by an aerial or road patrol and repaired. The leak from a pinhole poses negligible risk to the public (remote area, likelihood of ignition is very low, radiation zone is only a couple of metres). Where coating damage only occurs the CP system is in place to protect the pipeline. Where the strike results in pipe wall damage only (i.e. no leak), it may be detected by monitoring activities designed to detect coating damage (DCVG) or metal loss due to corrosion (ILI) where these techniques are applied. However, detection may not occur for many years after the event (i.e. due to frequency of monitoring and whether damage is sufficient to be detected).

Risk Assessment

Safety Risk:

Consequence: The leak from a pinhole poses negligible risk to the public (likelihood of ignition is very low, radiation zone is only a couple of metres).

Minor

Frequency: The leak from a pinhole poses negligible risk to the public (likelihood of ignition is very low, radiation zone is only a couple of metres).

Hypothetical

Safety Risk Category : Negligible ✓

Supply Risk:

Consequence: Pinhole leak is expected to result in short term supply constraint (2-3 days). Jemena will have suitable spare line pipes and weld procedures to undertake:o blowdown/cold cut/weld in new pipe;o Blow down and weld pressure containing sleeves; oro Install mechanical clamps that are capable of containing leaks, in this case, the affected section can be blown down to low pressure (<1MPa) and the clamp installed. The Clamp is rated to EGP pressure rating. All of the above repair options are expected to take less than 2-3 days in an emergency scenario. It is also possible that APA may be able to supply Sydney distribution network, this would require co-ordination with AEMO and the market.Jemena can maintain some supply to the EGP via Longford albeit at a significantly reduced rate.

Major

Frequency: The APGA Pipeline Operators Group (POG) Incident Database records four instances of pinhole leaks in thin wall pipe (i.e less than 6.5mm WT) caused by lightning strikes in Australia. Where gas release have occurred, they are in the northern parts of Australia. Frequency of lightning strikes are less in Southern Australia. Increased EGP wall thickness decreases likelihood of through wall pinhole.

Hypothetical

Supply Risk Category : Low ✓

N-015-FLO Major erosion at river/creek crossing

Category: NaturalEvents

Description: Flooding or high rain event causes high flow through watercourse leading to erosion of pipe cover, leading to flotation of pipe and exceeding allowable stresses.

Control by design and/or procedures

Major waterway crossings are installed by HDD at depths of approximately 10.7m and 15.0m below the Gurungaty Waterway and Allans Creek Crossings respectively. Erosion is controlled by depth of burial.

Threat is controlled ✓

O-002-MGL Facilities - Minor gas leak

Category: OperationsMaintenance

Description: Activity - minor gas leak, due to weeping flange, pinhole leak from lightning strike, etc
Threat - Nil. (Note that fire threat is very remote, because there is no ignition source)

Control by design and/or procedures

1) Design, testing and commissioning to eliminate leakage.
2) Maintenance procedures to periodically inspect site for leakage – station checks as per the PIMP- includes leak detection using gas detector and/or snoop test

Threat is controlled ✓

O-003-FTG Fatigue due to pressure cycling

Category: OperationsMaintenance

Description: Threat: Fatigue from pressure cycling not designed for - results in pipeline leak and loss of containment

Control by design and/or procedures

Pipeline not designed for pack and deplete operation. Pipeline will be continuously operated in steady state mode. Operating pressure typically 12MPa, therefore pressure cycles would be small in magnitude.

Refer GAS-556-DG-DN-001, Section 7.8
"No fatigue life assessment has been carried out for PKP and CL pipelines because the operation philosophy expects no significant pressure cycling.
The pipeline shall undergo a fatigue life assessment per AS/NZS 2885.1 Appendix J if pipeline operation philosophy changes and will experience significant pressure cycling or frequent start-up (pressurisation) / shut-down (de-pressurisation). In this scenario, an engineering assessment and calculation shall be undertaken to assess fatigue risk to the pipeline and provide acceptable limits to the cycling of the pipeline.
Appendix J of AS/NZS 2885.1 recommends using the simplified approach to determine the fatigue life, where the amplitude stress range is within 35 and 165 MPag. Where the daily hoop stress range is below 35 MPag, a fatigue assessment is not required."

Threat is controlled ✓

References

29 GAS-599-DG-DN-001 Project Marlin: EGP Reversal Facilities Design Basis Manual

O-004-GEN General Operations and Maintenance Threats

Category: OperationsMaintenance

Description:

Control by design and/or procedures

The EGP (and proposed Port Kembla Pipeline and (Out of Scope) Cringila Lateral Pipeline) are operated and maintained in accordance with the EGP Safety Management Manual (Document No. TBC) and the Safety Case (SAOP) for Jemena Gas Assets (NSW) (GAS-999-PA-HSE-002), (Appendix C addresses pipeline integrity management) and associated policies, procedures and work instructions. These documents have been developed to meet the requirements of AS 2885.3-2012 Pipelines - Gas and liquid petroleum - Operations and Maintenance.

The pipeline is controlled from Jemena's control room in Melbourne that is staffed 24 hours a day, seven days a week.

Day-to-day operations and maintenance activities are managed out of Jemena's (Zinfra) Kembla Grange office. This includes patrolling and site watch for third party activities on the easement / land.

The structural integrity of the Port Kembla Pipeline will be managed by the Jemena's Assest Management (Gas Markets) Team in accordance with the EGP Safety Management Manual (TBC) and the Safety Case (SAOP) for Jemena Gas Assets (NSW) (GAS-999-PA-HSE-002). This group also reviews encroachment requests (through DBYD) referred to them by Jemena's Land Management team due to special circumstances or the large scale of the proposed works, to assess and approve third party activities on the pipeline easement / land.

An Asset Performance and Integrity Report (APAIR) is prepared annually (based on data from the Annual Corrosion Control Reports (updated every 12 months) and External interference and Pipeline Route report (updated every 24 months)) to review the condition of the EGP based on activities for the previous 12 months and develop actions to be included in the Action Class Strategy.

Maintenance of the EGP's facilities and equipment is scheduled through work planning using SAP and undertaken against work instructions. Maintenance planning is completed on a facility by facility basis and is aligned to the authorised maintenance program. Maintenance Procedures, work instruction etc., are reviewed on an as-needed basis. There is a monthly reporting process in place to monitor that maintenance is occurring as per the maintenance schedule.

Activies such as landholder liaison and council liaison are managed in accordance with the JGN Landholder Engagement Plan (GAS-1499-PA-LM-002). Pipeline awareness campaigns and stakeholder engaged is managed in accordance with the NSW Stakeholder Engagement Plan (Gas) (GAS-1499-PA-LM-001) be the Lands Management Team. First response to DBYD requests, approval and supervision of third party works are managed by the GIS Crossing Notification System (CNS) and the third party fuideline document Guideline to designing, constructing and operating around existing AS2885 natural gas pipelines (GAS-960-GL-PL-001).

Systems and procedures are subject to compliance auditing in accordance with the procedures and schedule established in accordance with the PMS.

Spare line pipe will be kept at the end of this project for emergency repairs.

Inspection frequencies etc. currently envisaged to be as per existing EGP.

Threat is controlled ✓

APPENDIX 5 CONSOLIDATED ACTIONS REPORT

SMS Actions

2021-FEED-001 Extend existing armco railing east of KGMS

Status: Closed

Description: The existing Kembla Grange Mainline Valve Station is protected from 4WD rollover from the embankment to the East. This railing should be extended to protect the new Kembla Grange Meter Station. Incorporate into FEED KGMS GA drawings.Liaison with landowner will be required.

Priority: Before Next SMS Review

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 24/11/2020 12:00:00 AM

Close-out Comments: Requirement for armco barrier extension has been conveyed to facilities design team and will be included on the KGMS facility drawings.

2021-FEED-002 Pipeline casing/slab adjacent power poles within close proximity of pipeline

Status: Closed

Description: Confirm actualy distance of power poles from pipeline along alignment. Identified locations where power poles are close to new pipeline include:1) Lathe Pl adjacent HDD exit pit. - KP1.1 - approximate clearance to power pole is 5m.2) Berkely Street Substation area - trenched alignment is relatively close to major powerlines / poles.3) End of Wyllie Road (KP4.7 to KP4.8) - two power poles located between exiting Port Kembla Lateral Pipeline alignment and proposed Port Kembla Lateral Looping PipelineReview separation between power pole footings and new pipeline and consider installing protection slabs at these locations.

Priority: Before Next SMS Review

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 24/11/2020 12:00:00 AM

Close-out Comments: Follow up meeting held 19/11/2020.
Attendees:
-Dario Stella (Jemena)
-Max Imsungnoen (Jemena)
-Raj Jeyarajah (Jemena)
-Rasool Mayahi (GPA)
-Sarah Greening (GPA)
-Zachary Hill (GPA)

Reviewed separation between power pole and PKLL pipeline at KP1.1. 5m horizontal separation. Burial depth at this location is ~3m per revC alignment sheets, but this is subject to final HDD design. Exit pit location is also subject to final HDD design.
Recent 5-yearly review SMS for EGP (including the existing Port Kembla Lateral which also passes this same power pole) concluded that signage should be installed at high risk power poles.
It was raised that it is less likely for a replacement pole to be offset by any significant distance laterally as this is limited by the length of the power lines. It is more likely to be offset axially, in the direction of the pipeline.

It was agreed:
-If the exit pit extends to the location of the power pole, then the opportunity should be taken to install a protective slab. The details would be confirmed during design but would typically be for a length of 10m total along the pipeline route (i.e. 5 m in both directions from the power pole).
-If the exit pit does not extend to the power pole, then the pipe will not be exposed during construction (HDD install) and no protection slab will be installed.
-Regardless, extra signage to be installed at this location, either side of the pole pole and on the power pole subject to liaison with utility owner.
-Signage and separation depth are the primary controls.
-Location of exit pit and HDD profile at KP1.1 to be reviewed at detailed design/pre-construction SMS review and inclusion of protection slab confirmed or removed.
-Similarly, other identified locations (Berkely Street and Wyllie Road) to be reviewed in detailed design and inclusion of protection slab confirmed or removed.

2021-FEED-003 Crossing drawing for existing Port Kembla Lateral crossing at KP2.1

Status: Closed

Description: Location specific crossing drawing to be generated for the crossing of the existing Port Kembla Lateral at KP2.1. To include crossing above or below.

Priority: Before Next SMS Review

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 24/11/2020 12:00:00 AM

Close-out Comments: Followed up at weekly technical meeting 10/11/2020.

Agreed to defer crossing detail drawing to detailed design.
Review action close out at detailed design SMS review.

2021-FEED-004 Buoyancy at wetland crossing

Status: Closed

Description: Buoyancy calculation to be completed to confirm the requirement for buoyancy control at the wetland crossing KP4.15 to KP4.25.

Priority: Before Next SMS Review

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 24/11/2020 12:00:00 AM

Close-out Comments: Followed up at weekly technical meeting 10/11/2020.

Buoyancy calculation will be completed as part of FEED.

2021-FEED-005 Culvert extension

Status: Closed

Description: Existing stormwater culvert adjacent Kembla Grange Mainline Valve Station to be extended past the entrance to the Kembla Grange Meter Station.

Priority: Before Next SMS Review

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 24/11/2020 12:00:00 AM

Close-out Comments: Requirement for culvert extension has been conveyed to facilities design team and will be included on the KGMS facility drawings.

2021-FEED-006 General Design, Materials and Construction Threats

Status: Closed

Description: Jemena to advise controls in place (i.e. project execution plan) to ensure general design, materials and construction quality risks.

Priority: Before Next SMS Review

Responsible: Jemena - Nathan Biggins

Closed by: GPA - Zac Hill

Close-out date: 1/10/2021 12:00:00 AM

Close-out Comments: Quality Management Plan provided to GPA

2021-FEED-007 Confirm whether peat fire is a credible risk

Status: Closed

Description: Confirm the presence of peat along the alignment. Jemena noted that Acid Sulfate Soils are an indicator that peat could be present. There are Acid Sulfate Soils near HDD-1 at Cringila end.

Priority: Before Next SMS Review

Responsible: Jemena - Nathan Biggins

Closed by: GPA - Zac Hill

Close-out date: 24/11/2020 12:00:00 AM

Close-out Comments: Follow up meeting 19/11/2020.
Attendees:
-Dario Stella (Jemena)
-Max Imsungnoen (Jemena)
-Raj Jeyarajah (Jemena)
-Rasool Mayahi (GPA)
-Sarah Greening (GPA)
-Zachary Hill (GPA)

Reviewed discussion in geotech report GAS-556-RP-GI-001 which identifies potential for acid sulfate soils at TL07 (eastern end of HDD-01 at Cringila end of alignment).
Peat is a deposit formed by partial decomposition of vegetation or organic matter.
While there is no mention of organic matter being found in the geotech report, the presence of acid sulfate soils was noted as a potential link to presence of peat.
In order for a peat fire to start, there must be a source of ignition. While bushfire risk is low in the area, industrial fire is possible given the land use.
This threat was reviewed as part of the EGP 5-yearly review. Jemena undertook some work to understand the risk to pipeline integrity including HYSYS modelling for pipe surface temperature. It concluded that the pipe wall would not exceed 50degC.

It was agreed:
-Cannot discount the risk of peat fire as 'non-credible'. But the justifications/controls applied in the EGP 5-yearly SMS can be applied here.

2021-FEED-008 Confirm EGP hot tap location

Status: Closed

Description: There was a discrepancy between the surveyed EGP location and the GIS EGP location at the point of hot tap/tie-in of the new lateral looping pipeline. Jemena to confirm on site and advise the design team.

Priority: Before Next SMS Review

Responsible: Jemena - Nathan Biggins

Closed by: GPA - Zac Hill

Close-out date: 30/09/2021 12:00:00 AM

Close-out Comments: An updated survey was received 12/05/2021 (file name: GAS-556-PA-SV-001 rev1). Location of EGP and depth of cover has now been confirmed.

2021-FEED-009 Update alignment sheets

Status: Closed

Description: Alignment sheets to be updated to reflect the location classes as documented in the SMS workshop record.

Priority: Before Next SMS Review

Responsible: Jemena - Nathan Biggins

Closed by: GPA - Zac Hill

Close-out date: 29/10/2021 12:00:00 AM

Close-out Comments: Alignment sheets have been updated with new location classes.

2021-FEED-010 Confirm Land Use and External Interference Threats

Status: Closed

Description: The detailed design process should include documented land user surveys and threat investigations to confirm the threats to the pipeline for review during the detailed design SMS. This particularly applies to threats for Segment 1. Significant threats have been identified but require sufficient definition to provide for a valid external interference protection assessment; these include: 1) HDD crossings at watercourses (Gurungaty Waterway and Allans Creek); 2) threats along the wharf access road to the onshore receiving facility; 3) activities in the common infrastructure corridor parallel to Springhill Road).(Note that the Segment 2 threat definition is based on the EGP SMS (which includes the existing Port Kembla Lateral) and also the PKP Segment 2 workshop review - in both cases the workshops were attended by Jemena field personnel familiar with activities and equipment used for the section between Cringila and Kembla Grange Offtake).

Priority: Before Next SMS Review

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 29/10/2021 12:00:00 AM

Close-out Comments: This action is now closed on the basis that the land use and external interference threats were discussed at the Detailed Design SMS.

2021-FEED-011 Review Nitrogen Release Measurement Length

Status: Closed

Description: The FEED SMS review was based on an oxygen concentration limit of 19.5% which is considered the minimum 'safe level' by Safework Australia. This is considered conservative as the definition of the measurement length under AS 2885 is the contour of an ignited gas release with a radiation intensity of 4.7kW/m2 which will cause at least second degree burns after 30 seconds. AS 2885 also requires the determination of the radiation contour for a radiation intensity of 12.6kW/m2 which is the threshold of fatality and will cause third degree burns after 30 seconds (the oxygen concentration decreases as the distances from the pipeline decreases).The detailed design SMS shall review the basis for determining the equivalent measurement length for the Cringila Lateral Pipeline (nitrogen service). Jemena shall approve the methodology and basis for selection of the oxygen concentration limit.

Priority: Before Next SMS Review

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 30/09/2021 12:00:00 AM

Close-out Comments: A calculation has been developed to determine the 'equivalent measurement length' for the nitrogen pipeline - Doc No. GAS-558-CA-PL-001.
The calculation has been based on the extent at which the oxygen content drops below 19.5%, which is the minimum safe oxygen content in air as defined by the Safe Work Australia document 'Guidance on the Interpretation of Work Place Exposure Standards for Airborne Contaminants'.

2021-DD-001 Update Regulatory Approval Documentation

Status: Closed

Description: Planning NSW noted in the workshop that it appeared the design as it stands is not aligned with the Regulatory Approval documents to date. ACTION: Jemena to update planning approval document so that it is consistent with the current design.

Priority: Before Construction

Responsible: Jemena - Nathan Biggins

Closed by: Jemena - Nathan Biggins

Close-out date: 24/11/2021 12:00:00 AM

Close-out Comments: Jemena advised that at the end of the SMS, Nathan spoke to Warren Woodhouse (DPIE) regarding his comment which led to this action. Warren was reminded of the pipeline diameter and pressure which was fully considered in the modification for segment 2 including the hazard assessment. Warren then agreed that everything was ok and progressing in line with the regulatory planning approvals."

2021-DD-002 Tsunami Threat

Status: Closed

Description: The question was raised in the workshop whether the above-ground facility at PKGT may be exposed to tsunami conditions. ACTION: Confirm whether a tsunami is a credible threat and determine whether this needs to be considered by the design.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

Closed by: Jemena - Michael Peoples

Close-out date: 7/12/2021 12:00:00 AM

Close-out Comments: AIE have provided PKGT-AIE-FEED-0155 Rev. 0 Observation and Simulation of Infragravity and Far-Infragravity Waves. The conclusion is that Tsunami waves reach no higher than 0.4m which is based on theoretical modelling and three measured Tsunamis – December 2004 Sumatra-Andaman, February 2010 Chile, and March 2011 Sendai Japan. Based on this, the threat of damage to PKGT facility due to a tsunami is not considered credible.

2021-DD-003 Security Provisions for Facilities on land owner by third party

Status: Closed

Description: The facility at PKGT will be owned by AIE and the facility at Cringila will be owned by BOC, both will be operated by Jemena. ACTION: Jemena to liaise with these facility owners so that the single facility security system meets the requirements of both parties at each location.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

Closed by: Jemena - Michael Peoples

Close-out date: 7/12/2021 12:00:00 AM

Close-out Comments: Jemena have advised they will complete a detailed Access Instruction against the Maritime Transport and Offshore Facilities Security Act / Regulations to operate on Port of NSW land which includes all aspects of site access and security.

2021-DD-004 Marker Tape Requirements

Status: Closed

Description: ACTION: Review marker tape requirements to confirm the following: 1. Should the tape be fanned to provide slack in the marker tape such that it does not break when pulled up by an excavator bucket (e.g. taking into account the mechanical properties of the marker tape). 2. Should two tapes be laid side-by-side given the diameter of the pipe and the width of the marker tape.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

Closed by: Jemena - Nathan Biggins

Close-out date: 24/11/2021 12:00:00 AM

Close-out Comments: Jemena have reviewed the suggestion by Safe Work to fan the marker tape or lay two tapes side by side. Jemena's standard design and specification has been confirmed to comply with AS2885.1 with no further action being required.

2021-DD-005 Northcliffe Drive Upgrade

Status: Closed

Description: Wollongong City Council plan to extend Northcliffe Drive north of the Princes HIghway in future. This will include a flyover of the Illawarra Railway and will traverse the PKP easement (~KP10.45). Construction of the flyover will include piling to construct the flyover access ramps. Jemena advised that they have dealt with similar road upgrades to the proposed Northcliffe Drive upgrade on other pipelines and developed site-specific requirements for these projects. ACTION: Jemena to review the pipeline design at this location (~KP10.45) and apply a consistent design philosophy with regards to physical protection measures for the Northcliffe Drvie location.

Priority: Before Construction

Responsible: Jemena - Max Imsungnoen

Closed by: Jemena - Max Imsungnoen

Close-out date: 24/11/2021 12:00:00 AM

Close-out Comments: Jemena have advised that an engineering assessment was conducted and a follow up design review was carried out on 13/10/21 with council. Discussion was made with respect to the requirements that will be imposed on contractors when working within Jemena gas pipeline easement, these measures include but not limited to stress analysis, coating defect survey and mechanical protection in the form of concrete slabbing are to be provided by the contractor. Council were made aware of these requirements and no physical protection in a form of concrete slabbing was requested nor agreed to be implemented during the installation of the gas pipeline to accommodate for the future proposed road extension works at the time of discussion.

2021-DD-006 Signage for HDD sections

Status: Closed

Description: HDD crossing lengths and locations on this pipeline may not allow installation of signage that meets the spacing distances required in AS2885.1, (i.e. HDD's are under roads, rivers, buildings). ACTION: GPA to liaise with Jemena to confirm signage requirements philosophy for HDD sections and document the outcomes, and then update the construction specification (GPA) and alignment sheets (Jemena) updated accordingly.

Priority: Before Construction

Responsible: GPA - Rasool Mayahi

Closed by: GPA - Zac Hill

Close-out date: 2/12/2021 12:00:00 AM

Close-out Comments: Requirements for signage at HDD sections has been updated in the construction specification. The requirement is for one sign at each end of the HDD (entry and exit pit) and additional sign on each end of the HDD at the location where the depth of cover reaches 5m, with additional signage as required to comply with the spacing requirements of AS/NZS 2885.1.

2021-DD-007 Vehicle Impact KGMS Facility

Status: Closed

Description: The swale adjacent KGMS in the current design may be encroached by the proposed Northcliffe Rd expansion design and therefore may not provide control for a vehicle departing the road towards the facility. ACTION: KGMS - review the vehicle impact threat and controls once Wylie Rd realignment and road design has been confirmed with the council. Review requirement for an armco barrier on the Wylie Rd side at KGMS.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

Closed by: Jemena - Michael Peoples

Close-out date: 7/12/2021 12:00:00 AM

Close-out Comments: Jemena have advised there has been a provisional realignment of Wylie Rd which has moved the road away from the meter station and Council has indicated they will allow for traffic management including site access. As part of approval for the revised Council design Jemena will mandate protection works including concrete slabbing and physical protection if warranted.

2021-DD-008 Physical Protection Requirement within Common Service Corridors

Status: Closed

Description: There are a number of common service corridors identified that require review to confirm the requirement for protection slab (e.g. the diagonal section in PKCT Road 1 where the PKP crosses from the verge to the roadway (KP0.56)). ACTION: Protection slabs to be added to the design at KP0.56. Similar locations and locations where the new pipeline crosses on top of an existing service shall be assessed on a case by case basis to determine the requirement for protection slab.This is to be documented before finalisation of the detailed design phase.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

Closed by: Jemena - Nathan Biggins

Close-out date: 24/11/2021 12:00:00 AM

Close-out Comments: Jemena have advised that slapping will be installed in accordance with our standard design and specification. This action is now closed.

2021-DD-009 Location Specific Crossing Drawings

Status: Closed

Description: There are a large number of services identified along the alignment, and it is expected that more may also exist, particularly within PKCT where records are less robust. ACTION: (1) Jemena to develop a vertical profile alignment of the pipeline based on as-built records of service crossings. (2) Specific crossing drawings to be developed on a case-by-case basis (i.e. required) for approvals by the third parties.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

Closed by: Jemena - Nathan Biggins

Close-out date: 24/11/2021 12:00:00 AM

Close-out Comments: Jemena have advised that targeted third party assets will be potholed during ECI and crossing sketches developed. Where a third party requires a specific crossing drawing for approval, this will be done on a case by case basis. These are not actions requiring tracking unde the SMS.

2021-DD-010 Earth Potential Rise Adjacent Power Poles between KP4 and KP5

Status: Closed

Description: There is a concern that the pipeline is located in close proximity to the power poles between KP4 and KP5 adjacent Springhill Rd on Bluescope land. Earth potential rise at these poles may transfer through to the pipeline. ACTION: Confirm whether these power poles have earth stakes. Once this is known, review and confirm assumptions in the LFI study and confirm they are valid in this location.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

Closed by: GPA - Zac Hill

Close-out date: 2/12/2021 12:00:00 AM

Close-out Comments: The concern here was elevated touch potentials (i.e. at the nearest test point) as a result of an earth fault on the power poles. Not long term effects on CP from a short transient fault. GPA confirm that this was considered in the CP design and is adressed by the design of the test points including the SSD at each test point, asphalt sandwich, and PPE as discussed in the AS4853 report and the CP design report.

2021-DD-011 Pipeline Depths Adjacent Temple (KP8.3)

Status: Closed

Description: Note Only: The new PKP pipeline and the existing PKL pipeline adjacent the temple do not have the same depth of cover. The existing PKL is installed deeper (1,500mm) than the minimum 1,200mm DOC required for the new PKP. This has been a conscious decision to minimise undermining or disturbing the existing pipeline. The as-built depths will be reflected in Jemena GIS and the as-built drawings. Operations have no issue with this as long as this is recorded on GIS.

Priority: Not Specified

Responsible:

2021-DD-012 External Interference during construction of proposed AIP powerline which shares alignment with PKP

Status: Closed

Description: There is potential for simultaneous construction of both the powerline and the PKP at ~KP9.8 onwards. AIP powerline is buried in this location. ACTION: Consultation is required with AIP to ensure threat of external interference during construction of the powerline is sufficiently controlled.

Priority: Before Construction

Responsible: Jemena - Nathan Biggins

Closed by: Jemena - Nathan Biggins

Close-out date: 24/11/2021 12:00:00 AM

Close-out Comments: Jemena have advised: Ongoing engagement with AIP by Jemena. This action doesn't require further tracking under the SMS.

2021-DD-013 Pipeline DOC Beneath Drainage Swale Near KGMLV

Status: Closed

Description: The PKP will be installed under an existing earthen drainage swale just North of KGMS. This drainage swale may be modified as part of the Northcliffe Drive upgrade to manage additional runoff volumes. ACTION: Review the requirement for additional depth of cover for: (1) Pipeline installed under/within the current drainage swale profile (before Northcliffe Dr/Wylie Rd modifications) - confirm if increased DOC required? (2) Consider whether additional DOC is required now to prepare the pipeline for the future Northcliffe Dr upgrade to have sufficient residual DOC should any drainage swale profile modifications be completed.

Priority: Before Construction

Responsible: Jemena - Max Imsungnoen

Closed by: Jemena - Max Imsungnoen

Close-out date: 24/11/2021 12:00:00 AM

Close-out Comments: Action 1 is closed – pipeline has sufficient DOC of min. 2.5m for current drainage swale profile. Action 2 is closed – Road extension 80% design issued by council doesn't appear to have much of an impact the existing swale drain north of KGMS and therefore current pipeline DOC is considered sufficient.

2021-DD-014 DN750 Waterline Anchor Block at KP10.1

Status: Open

Description: A DN750 waterline has been identified at KP10.1. It is anticipated there is a large anchor block at the bend in this waterline, which may be in the way of the current proposed alignment which passes close to the DN750 pipe centreline (based on GIS). ACTION: Review survey and if required confirm physical extents of the anchor block to determine if the PKP proposed design requires realignment to avoid a clash.

Priority: Before Construction

Responsible: Jemena - Max Imsungnoen

2021-DD-015 PKGT Security Risk Assessment

Status: Open

Description: Jemena have completed a security risk assessment for KGMS facility. ACTION: Security risk assessment for KGMS facility to be updated to include PKGT facility.

Priority: Before Construction

Responsible: Jemena - Michael Peoples

2021-DD-016 Location Class Coniston Public School

Status: Closed

Description: ACTION: Alignment sheets to be updated to reflect the Sensitive (S) secondary location class between KP2.4 and KP3.2 due to the proximity to Coniston Public School.

Priority: Before Construction

Responsible: Jemena - Max Imsungnoen

Closed by: GPA - Zac Hill

Close-out date: 1/04/2022 12:00:00 AM

Close-out Comments: Jemena (Thomas Toleman) advised that the location class around the Coniston Public School has been updated on the latest alignment sheet revision (GPA Email 220019-R57).