Business Case – Capital Expenditure
Pipeline Integrity
Business Case Number BC258 AA23-27

1 Project Approvals

TABLE 1: BUSINESS CASE – PROJECT APPROVALS

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2 Project Overview

TABLE 2: BUSINESS CASE – PROJECT OVERVIEW

Description of Issue/Project	The aim of the Integrity Management Program is to ensure that Victorian Transmission System buried gas pipelines remain fit for safe and reliable service. The integrity management program for buried transmission pipelines includes: • Inline inspections • Direct assessments • Verification and remediation excavations. Execution of the integrity management program allows APA to: • Periodically review the condition of each pipeline • Use the inspection data to recalibrate remaining life modelling • Apply efficient targeted remedial action campaigns. Pipeline Integrity is an ongoing program.
Options Considered	The following options have been considered: Option 1: Do Nothing Option Option 2: Integrity Management Program (Preferred option)
Estimated Cost	$27,641,733
Relevant Standards	Victorian Pipeline Regulations 2007 require under section 21 (2) that "For the purposes of section 109(a) of the Act, a pipeline must be operated in accordance with AS 2885.2-2020 and AS2885.3-2012.
Consistency with the National Gas Rules (NGR)	Pipeline integrity program complies with the new capital expenditure criteria in Rule 79 of the NGR because: • it is necessary to maintain and improve the safety of services and maintain the integrity of services (Rules 79(2)(c)(i) and (ii)); and • it is such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services (Rule 79(1)(a)).

Key Stakeholders	Landowners effects (noise, visual, third party encroachment etc.) Due to the need to use heavy equipment and potentially excavate on the easement, each project requires regular stakeholder consultation and negotiation. VTS stakeholder engagement group APA VTS presented draft replacement (stay-in-business) proposals at Roundtables and questions were raised about the size of the replacement capital expenditure forecast and the reasons for it. A large part of the increase relates to integrity management of ageing pipelines on the VTS.
Benefits to customers and consumers	The Pipeline Integrity Program provides a comprehensive and cost effective approach to inspecting pipelines for integrity issues. Ongoing inline inspection is the most effective method for preventing breakdowns and more costly reactive responses to address problems. The Pipeline Integrity Program provides the best value for maintaining safety and integrity of ageing pipelines on the VTS.

3 Background and project need

The Integrity Management Program business case brings together all aspects of buried transmission pipeline integrity management programs for the VTS. The scope of this document is for all pipelines managed in accordance with AS2885 and excludes station piping. Pipeline Integrity is an ongoing program and aligns to requirements under Victorian legislation.

The Victorian Pipeline Regulations 2007 require under section 21 (2) that "For the purposes of section 109(a) of the Act, a pipeline must be operated in accordance with AS 2885.2-2020 and AS2885.3-2012."

AS 2885.3:2012 has an entire section dedicated to Pipeline Integrity Management which requires the Licensee to ensure continued pipeline integrity. In addition, section 6.6.1 states "…periodic inspections shall be carried out to identify actual and potential factors that could affect the integrity of the pipeline."

APA maintains the Victorian pipelines in accordance with a Safety Case approved by Energy Safe Victoria. The Gas Safety Act 1997 section 44 requires "A gas company must comply with the accepted safety case for a facility in relation to the management and operation of the facility."

There are primarily two techniques to inspect an in-service pipeline:

- Direct Assessment (DA)
- Inline Inspection (ILI)

Assessment frequency is influenced by asset age and condition assessment, however the standard inspection frequency is 10 yearly.

3.1.1.1.1 Direct Assessment

The Direct Assessment technique is to excavate the pipeline, remove the coating and perform a non-destructive inspection (NDT) at regular intervals to determine a statistical confidence level as to the condition of the pipeline.

The Direct Assessment technique is acknowledged throughout the pipeline industry as the only means of determining the pipeline integrity where no other inspection technique is viable. APA utilises Direct Current Voltage Gradient (DCVG) surveys and other means to determine the location of where these DA are most likely to find a pipe wall defect.

APA undertakes a minimum of one inspection per kilometre of pipeline, with a minimum of two inspections per pipeline where DA is the primary means of integrity inspection.

3.1.1.1.2 Inline Inspection

For ageing pipelines on the VTS, inline inspection (ILI) and data analysis are more effective tools compared to DCVG as they identify pipeline defects for the whole pipeline rather than just coating defects (where coating has exposed the pipe).

The ILI technique involves advanced X, Y, Z geometry, Magnetic Flux Leakage and Ultrasonic Electromagnetic Acoustic Transducer (EMAT) tools (known as pigs) being inserted into the pipeline and pushed along in the gas stream. As they travel, the tools measure the pipe wall thickness around 360 degrees for the total length and can detect corrosion, geometric features and some tools can find cracks.

All VTS pipelines that are capable of being inspected with an ILI tool and that are at least 10 years old, have been inspected with the ILI technique. APA has a Metal Loss Pigging Frequency Policy to determine the ideal re-inspection interval. Re-inspection is based on calculation of a number of factors including predicted corrosion growth rate, location class, operating pressure and the remaining pipe wall thickness. A default period of 10 years applies to all VTS pipelines.

Inline inspection is the one of the most important and conclusive activities in a series of integrity management processes that allows pipeline deterioration to be identified and rectified prior to failure. Inline inspection allows for 100% of the pipeline to be inspected and provides confidence that defects will be detected. It is a more effective and efficient technique for monitoring pipelines compared to direct assessment.

The EMAT tool is capable of detecting cracking in the pipe. The cost of this tool is significantly higher and will be utilised on a risk basis. The drivers of the risk are similar to the assessment of Stress Corrosion Cracking (SCC) susceptibility:

- Pipeline operating at a stress level of ≥30% of Specified Minimum Yield Stress (SMYS)
- Pipeline traverses High Consequence Areas (HCA)
- Pipeline diameter ≥350mm nominal bore
- Pipeline mainline coating is coal tar enamel or field applied.

3.1.1.1.3 Pipelines not able to be pigged

There are several pipelines within the VTS that are not able to be inspected with conventional ILI technique. The integrity of these pipelines is currently managed using the DA technique, these inspections are listed in table 5.

A separate program to assess and prioritise conversion of unpiggable pipelines to enable inline inspection is covered separately in the BC259 FY23-27 VTS Unpiggables business case.

4 Risk Assessment

For a worst case scenario of metal-loss corrosion and damage it could be assumed that if the inline inspection is inadequate (or not carried out), that unknown corrosion could grow and ultimately develop to the point of failure. This is a significant failure mode with potential for; fatality of persons in the vicinity, constrained gas supply, media coverage and regulatory action.

For the purpose of the risk assessment, a period of 20 years has been utilised for the frequency (Remote) reflecting a significant period for an existing defect to grow to be capable of the worst case failure scenario. However, health and safety risk uses a frequency period of 50 years due to the lower likelihood of persons being in the vicinity during a failure event that then results in fatalities.

TABLE 3: RISK RATING

Risk Area	Consequence	Likelihood	Residual
Health and Safety	Fatality arising from systemic failure of APA safety or multiple fatalities of employees and contractors or members of the public	Remote [every 50yrs]	Moderate
Environment	One or a combination of the following consequences: - onsite and impacting > 1 ha - able to be remediated easily - impact continues for <1 yr	Remote [every 20yrs]	Negligible
Operational Capability	Unplanned interruption of ≥ 1 day but < 1 month to the delivery of firm services	Remote [every 20yrs]	Low
People	Some impact on Business unit engagement / rising complaints or breach levels / some staff turnover	Remote [every 20yrs]	Low
Compliance	Non-compliance with a contractual/legal obligation(s) - results in litigation	Remote [every 20yrs]	Low
Reputation & Customer	Sustained adverse national: - media articles on APA - viral social media Multiple negative reports by financial analysts	Remote [every 20yrs]	Low
Financial	$16M - $30M (estimated asset remediation and lost revenue cost)	Remote [every 20yrs]	Negligible
Residual Risk Rating			Moderate

5 Identification and Assessment of Options

The following demonstrates the need for each category of capital expenditure required for the Integrity Management Strategy.

5.1 Identification of Options

5.1.1 Option 1 – Do Nothing

The Do nothing option would continue the use of Direct Current Gradient Surveys (DCVG) to assess pipe coating integrity and to perform more frequent leakage survey. The DCVG technique provides a very limited information about pipeline integrity and cannot be relied on to detect metal loss in the pipeline.

In particular, where the coating is shielding, the DCVG cannot find that location. A shielding coating prevents the cathodic protection from working satisfactorily in that location and metal loss corrosion is highly likely. Examples of this are the corrosion found under failed heat shrink sleeves on the T1 Morwell to Dandenong pipeline (see Appendix A).

5.1.2 Option 2: Integrity Management Program

5.1.2.1 Inline Inspection

Inline inspection is the only certain method to locate external and internal corrosion, dents, gouges, cracks and other defects that affect integrity. It is a proven technology with many decades of successful delivery with increasingly capable tools. This information regarding the pipeline integrity enables condition assessment of the pipe and repairs scheduled as necessary. Alternatives, such as DCVG, produce a lower level of condition assessment for a higher cost.

5.1.2.2 Crack Detection

The integrity information provided by intelligent tools can be loosely categorised as; metal loss detection, geometry and crack detection. No single tool is capable of assessing the pipeline for all three categories.

The metal loss and geometry detection tools do not identify pipeline cracking. The contemporary tool is the metal loss detection and geometry tools and all of the pipelines listed in the table will be inspected using a metal loss and geometry tools. The crack detection tool is the most technically advanced inspection method available in the pipeline industry.

The purpose of using the crack detection tool is to identify any axial cracking, longitudinal weld seam cracking, crack clusters and interaction with existing or other anomalies.

The following pipelines will be inspected with a crack detection tool and thus their cost estimates differ when comparing on a cost per unit (length and diameter) rate:

- T60 - Longford to Dandenong S1
- T16 - Dandenong to West Melbourne
- T33 - South Melbourne to Brooklyn
- T60 - Longford to Dandenong S2
- T60 – Bunyip to Pakenham

This business case is for a program of work as described in the below table, ordered by year of inspection.

TABLE 4: INLINE INSPECTION SCHEDULE

Pipeline	Length (km)	Diameter (mm)	Cost	Year of ILI
T110 - James Street to Laverton Pipeline (253)	1.6	350	$456,733	2023
T37 - Tyers to Maryvale	5.4	150	$600,000	2023
T60 - Longford to Dandenong S1	174.2	750	$1,150,000	2023
T60 - Longford to Yallourn (L117/L120)	64.8	750	$600,000	2023
T96/T98 - Chiltern Valley to Rutherglen to Koonoomoo	103.5	200	$600,000	2023
T110 - SNOWY HYDRO	1.6	350	$600,000	2024
T16 - Dandenong to West Melbourne	36.2	750	$1,500,000	2024
T33 - South Melbourne to Brooklyn	12.8	750	$1,500,000	2024

T86 - Allansford to Portland	100.4	150	$600,000	2024
T102 - O'Hern's Road to Somerton	3.4	250	$600,000	2025
T24 - Brookyn to Corio	50.7	350	$600,000	2025
T74 - Wollert to Euroa to Wodonga	269.4	300	$1,200,000	2025
T85 - Kyabram to Echuca	30.7	150	$600,000	2025
T91 - Curdievale to Cobden	27.7	150	$600,000	2025
T93 - Codrington to Hamilton	54.6	150	$600,000	2025
T38 - Pakenham North	0.7	150	$600,000	2026
T119 - Wollert to Wodonga to Barnawartha	163.3	400	$600,000	2026
T81/T100 - Iona to Paarette to Allansford	41.1	150	$600,000	2027
	1142.1	347.22	$13,606,733	
	Total Length [km]	Average Diameter [mm]	Total Cost [$]	

Inline inspections are conducted regularly on APA pipelines, this enables cost to be based on actual inline inspection costs for similar pipelines. For an average pipeline the cost of MFL including cleaning runs is $600,000, where the integrity risk assessment determines that EMAT is required an additional $900,000 is added ($1,500,000). Inline inspections that have been priced above these values tend to be long section or involve inline inspection of several sections in one run.

5.1.2.3 Direct Assessment

Some of pipelines on the VTS were not designed and constructed to enable the ILI tool to pass through the pipeline to enable the necessary start and end of line valve arrangements to enable temporary pig launchers and receivers. For six of these pipelines it is not technically feasible to rectify the pipelines to permit ILI (refer Table 6 below). In addition, conventional ILI for small pipe diameters (less than 150mm nominal bore) is unlikely to be successful. In other cases, the operating stress level is low enough that rupture is not a credible failure mode, so the largest loss of containment event from corrosion would be a pinhole leak.

The DA technique is to excavate the pipeline, remove the coating and perform a non-destructive inspection (NDT) at regular intervals to determine a statistical confidence level as to the condition of the pipeline. This approach is the only satisfactory method of achieving compliance with AS2885.3 section 6.6.1 "…periodic inspections shall be carried out to identify actual and potential problems that could affect the integrity of the pipeline."

TABLE 5: DIRECT ASSESSMENT SCHEDULE (UNPIGGABLE PIPELINES)

Pipeline Section	Diameter	Length (km)	Year
T1.1 - Jeeralang Supply	300	0.4	**1978**
T65 - Princes Hwy/Henty Street	500	0.2	**1981**
T44 – Lardner to Warrigul	100	4.8	**1975**
T74 – Keon Park – Wollert	600	0.24	**1976**
T109 – Illuka Supply	100	1.1	**2005**
T38 - Pakenham/KooweeRup Road MS	80	0.5	**1972**

Due to the minor expense (approximately $15,000 each) for the DCVG surveys used to locate coating defects for DA excavations, they have been incorporated into the verification and remediation excavation costs in table 6.

5.1.2.4 Post Inspection Verification and Remediation Excavations

Table 6 provides the anticipated cost and schedule for verification and remediation excavations following inspections. The scope and locations for each pipeline are defined using the inline inspection data.

Estimated costs for an average pipeline length are based on an allowance of 10 excavations at $50,000 each. Initially 5 excavations are target the largest features identified in the inspection results, these are used to prove and calibrate the data. An allowance is made for 5 additional excavations but subject to pipeline condition and length these may not be required, however on average 10 excavations are anticipated.

TABLE 6: POST INSPECTION VERIFICATION AND REMEDIATION EXCAVATION SCHEDULE

Title	Estimated Cost	Year
T1.1 - Jeeralang Supply	$200,000	2023
T38 - Pakenham to Kooweeup	$200,000	2023
T60 - Bunyip to Pakenham	$500,000	2023
T60 - Longford to Dandenong S2	$500,000	2023
T63 - Tyers to Morwell	$300,000	2023
T64 - Newport	$500,000	2023
T74 - Keon Park to Wollert	$385,000	2023
T99 Barnawartha to Culcairn	$500,000	2023
2023 DCVG Survey/Digs	$500,000	2023
T37 - Tyers to Maryvale	$500,000	2024
T60 - Longford to Dandenong S1	$500,000	2024
T60 - Longford to Yallourn (L117/L120)	$500,000	2024
T96/T98 - Chiltern Valley to Rutherglen to Koonoomoo	$250,000	2024
2024 DCVG Survey/Digs	$500,000	2024
T110 - SNOWY HYDRO	$500,000	2025
T16 - Dandenong to West Melbourne	$500,000	2025
T33 - South Melbourne to Brooklyn	$500,000	2025
T65 - Princess Highway to Henty Street	$200,000	2025
T86 - Allansford to Portland	$500,000	2025
2025 DCVG Survey/Digs	$500,000	2025
T102 - O'Hern's Road to Somerton	$500,000	2026
T24 - Brookyn to Corio	$500,000	2026
T74 - Wollert to Euroa to Wodonga	$1,000,000	2026
T85 - Kyabram to Echuca	$500,000	2026
T91 - Curdievale to Cobden	$500,000	2026
T93 - Codrington to Hamilton	$500,000	2026

2026 DCVG Survey/Digs	$500,000	2026
T119 - Wollert to Wodonga to Barnawartha	$500,000	2027
T38 - Pakenham North	$500,000	2027
2027 DCVG Survey/Digs	$500,000	2027
Total	$14,035,000	

5.1.3 Assessment of Options

5.1.3.1 Option 1 Do nothing

Not a credible option as it does not reflect good industry practice for pipeline integrity management and will not meet ALARP. The Do nothing option would result in deterioration of asset integrity and risk safety and reliability of supply, i.e. an unsustainable practice. The pipelines on the VTS are ageing and require regular inspection of the whole pipeline which is not provided by Direct Assessment or other lower cost approaches.

5.1.3.2 Option 2 Integrity Management Program (preferred option)

Option 2 involves continuing with industry accepted pipeline condition monitoring practices to manage integrity for VTS in-service pipelines. Option 2 predominantly relies on periodic inline inspections (ILI) to detect faults and intervene with inspection and repair campaigns before they escalate to loss of containment incidents. Identifying and managing pipeline integrity issues before they fail is a cost effective way to avoid rectification in the event of a loss of containment and also avoids the potential for incident escalations as explored in the Risk Assessment.

The only alternative to ILI is the direct assessment (DA) technique, direct assessments are used on assets not configured for inline inspection, they are a low cost approach for short sections of pipeline but do not provide the condition confidance of an inline inspection. To get an indication of VTS pipeline condition with equivalent confidence of ILI, a large number of direct assessments would be required, this would require at least 2,000 individual inspections of the VTS pipelines. The cost of these inspections could be reasonably averaged at $40,000 per inspection which would require a total inspection program cost of over $80,000,000.

Direct assessment programs are statistical in nature and do not directly target anomalies, whereas the preferred option of ILI provides a conclusive result of pipeline condition. This is especially the case with ageing assets. The cost/benefit of direct assessment is economically unfeasible whilst increasing the risk level due to the unknowns with the direct assessment program. Whereas inline inspection data specifies the defect location enabling efficient targeted excavation, assessment and remediation to occur, so while inline inspection costs more it offers a more cost-effective approach to comprehensive monitoring of ageing VTS pipelines.

Option 2 will maintain the moderate risk rating and do so in the most financially prudent manner so has been selected as the preferred option.

TABLE 7: SUMMARY

Option	Description	Costs
Option 1	Do Nothing	**Indeterminate**
Option 2a	Inline Inspection	**$13,606,733**

Option 2b	Verification and Remediation Excavations (including DCVG surveys)[1]	**$14,035,000**
	Integrity Management Program total	**$27,641,733**

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	Total
Internal Labour	$1,500,000
Materials	$2,650,000
Contracted Labour	$22,991,733
Other Costs	$500,000
Total	$27,641,733

5.1.4 Consistency with the National Gas Rules

Consistent with the requirements of Rule 79 of the National Gas Rules, APA considers that the capital expenditure is:

Prudent
The expenditure is necessary in order to maintain and improve the safety of services and maintain the integrity of services to customers and personnel and is of a nature that a prudent service provider would incur. The Integrity Management Program aligns with AS2885 and meets the ALARP principle.

Efficient
APA tenders the provision of ILI services on a competitive basis. The works will be subject to APA procurement policies. The works will be carried out by external contractor who demonstrate specific expertise in completing the installation of the facilities in a safe and cost effective manner. The expenditure can therefore be considered consistent with the expenditure that a prudent service provider acting efficiently would incur.

Consistent with accepted and good industry practice
ILI is a proven technology used worldwide for demonstrating pipeline integrity. Direct Assessment is accepted as good industry practice where ILI is not practical.

To achieve the lowest sustainable cost of delivering pipeline services
ILI is the most cost effective solution and has been approved by the AER for many other pipeline assets.

5.1.5 Forecast Cost Breakdown

The methodology to forecast costs has been based on using historic costs for similar works and applying that to the number and length of the pipelines.

[1] Due to the low cost of DCVG surveys they have been included in the verification and remediation excavations.

5.1.5.1.1 Inline Inspection

The costs of ILI are dependent on pipeline length, diameter, exchange rate, some fixed costs and need to relocate launch and receiving facilities. APA has a contract with a provider of ILI services where the cost is calculated by length, diameter and tool type per run.

The cost of crack detection tools is greatly influenced by the data processing costs which are depend on the number of features detected by the tool (the number of defects on the pipeline). APA VTS has provided the best estimate of this cost with the information available at this time.

5.1.5.1.2 Direct Assessment

The cost of DA depends greatly on the cost of excavation, reinstatement and recoating. All of these costs are dependent on pipe diameter, depth, surface conditions such as roads, pavement and grass or other. The exact locations of each DA has not yet been determined as a DCVG is required to identify coating defects.

5.1.5.1.3 Post Inspection Verification and Remediation Excavations

The cost of verification and remediation excavations has been set based on prior learnings, a default value of $500,000 is budgeted to cover the cost of conducting 5 verification digs and 5 remediation digs. Verification digs are used to verify the inline inspection data and enable calibration. Based on the findings of the verification digs the remediation digs are completed, note repairs could be required at either verification or remediation digs but they are not considered in this budget. Some pipelines will require substantial repairs depending on condition, while others will require less the excavation budget applied is an average value based on previous dig campaigns.

6 Acronyms

Acronym	Definition/Description
AEMO	Australian Energy Market Operator
AGA	Australian gas association – Type B compliance governing body
API	American Petroleum Institute – publisher of standards
CHAZOP	Control system HAZOP – study of the control system functions to identify logic vulnerabilities
ESD	Emergency shutdown – control system-initiated shutdown designed to prevent incident escalation if operating parameters are breached
ESV	Energy Safe Victoria
HAZOP	Hazard and operability study
HMI	Human machine interface
ILI	Inline inspection – pipeline internal inspection
OEM	Original Equipment Manufacturer
RA	Risk Assessment
RBI	Risk Based Inspection – a process used to prioritise maintenance or inspection activities based on risk of failure.
SIL	Safety Integrity Level – an assessment used to rank control systems by their ability to fail safely
SMS	Safety Management Study
VTS	Victorian Transmission System

7 Appendix

Appendix A – Photographic Evidence of Heat Shrink Sleeve Failure

The following images were taken from the Morwell to Dandenong Pipeline constructed with coal tar enamel (black), with enamel joint coatings (black). The heat shrink sleeves (yellow) were used as coating repair sleeves for many years.

The disbonded coating is shielding the cathodic protection from working. This phenomenon is undetectable by DCVG as the shielding prevents any indication of coating failure.

Image 1: Transition from original coal tar to the yellow heat shrink sleeve applied by the G&F Corporation.

Image 2: The disbonded heat shrink sleeve is clearly evident on visual inspection

Image 3: Extensive disbondment

Image 4: Pipe condition under disbonded coating