Business Case – Capital Expenditure
Pipeline Fracture Resistance Assessment
Business Case Number BC331 AA23-27

TABLE 1: BUSINESS CASE – PROJECT APPROVALS

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TABLE 2: BUSINESS CASE – PROJECT OVERVIEW

Description of Issue/Project	The aim of this business case is to maintain AS2855 compliance after Fracture Resistance Assessment requirements were recently introduced and come into effect 2023. The business case also ensures ALARP risk level for pipeline rupture as a result of third-party interference and pipeline defects. Fracture Control Plans for existing VTS pipelines are reviewed against latest edition of AS2885.1 as part of ongoing compliance and currency of the Plan as required by AS2885. Where a new provision is considered very significant from a safety or technical viewpoint it may be required to be applied retrospectively. APA has identified through SMS workshops that rupture may occur in circumstances where existing physical and procedural controls fail. To demonstrate ALARP for this threat, existing pipelines should be reviewed against latest edition Fracture Control requirements for compliance. This Business Case will identify the requirements, testing and documentation to ensure compliance. The following has been identified to ensure transmission pipeline compliance to latest edition AS2885.1 requirements: Hot Tapping and Live welding of VTS pipelines to obtain material sample(coupons) for Fracture Toughness testing Cut-out of abandoned sections of VTS pipeline for Fracture Toughness testing Fracture Toughness testing of existing pipe sections and hot tapping coupons in APA storage
Options Considered	The following options have been considered: Option 1: Do Nothing Option Option 2: Comply with AS2855 Fracture Resistance Assessment requirements (Preferred option)
Estimated Cost	$1,430,000
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 AS2855-2012.
Consistency with the National Gas Rules (NGR)	Conducting Pipeline Fracture Resistance Assessments 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	Landowner 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. AEMO due to live welding on VTS pipelines. Operating conditions and approvals need to be agreed upon. ESV for approval of Project Documentation and compliance with applicable standards

Benefits to customers and consumers	Retrospective compliance of existing VTS pipelines to Fracture requirements of latest edition standards ensures best practice and minimises potential for rupture of pipeline in worst case scenarios. ALARP is demonstrated for this threat. The Fracture Assurance program provides the best value for maintaining safety and integrity of ageing pipelines on the VTS.

1 Background

Recently the pipeline industry has become more aware that legacy pipelines may be susceptible to uncontrolled fracture propagation in the event of a fracture initiation incident. This is because the pipelines were constructed before current fracture control requirements were put in place. In this circumstance, the pipe may not have received fracture toughness testing, or the records may have been lost. This concern is being addressed by pipeline owners through the assessment of the fracture control properties present in legacy pipelines and their comparison with fracture control plan requirements. Where gaps are evident, mitigating controls can be put in place.

APA owns and maintains the Victorian Transmission System which is a network of gas pipelines of varying ages. In each case the design and construction of the pipeline met the requirements of the applicable design and material codes as they existed at the time of design. Over time, these codes and standards have changed; evolving to meet advances in the understanding of the industry of those factors necessary to achieve a safe and efficient pipeline. This process means that older pipelines do not necessarily meet the requirements of newer versions of the standards. AS2885, the ruling standard for gas pipeline design, deals with this circumstance in Part 0, Section 1.6.1" Retrospective Application". The standard specifically does not require the retrospective application of a new provision to an old pipeline. However, it does require that all pipelines be maintained and operated, to the extent practicable, to the current version of AS2885.3, and allows that where a new provision is considered very significant from a safety or technical viewpoint it may be required to be applied retrospectively.

The current revision of the standard AS2885.1:2018 was formulated by a committee drawn from industry subject specialists. It is an extensive revision and provisions for pipeline fracture control were reviewed and updated to reflect the most current understanding. The prospect of the revision requiring retrospective assessment and conformity to some fracture control standards has been informed by recent international and national events. Overseas, the San Bruno event has focussed the industry on the prospect of a failure of a legacy pipeline, and the consequences should a similar event occur in Australia. Locally, the publication of an article in the Australian Pipeliner, has raised questions about the integrity of legacy pipelines and their management practices. John Piper & Associates Pty Ltd Fracture Control in Legacy Pipelines 5-04-16 Page 2 of 11 Revision 2 Client: ITI for APA Group

AS 2885 in general is not retrospective - see Clause 1.6.1 of AS2885.0-2018. Hence the fracture control requirements do not apply to pipelines built earlier than that. However, the forthcoming revision of AS2885 Part 3 will require a fracture resistance assessment. Among other things that includes an assessment of risks using the SMS process of Part 6, and further actions to manage risk may arise from that.

APA is in the process of conducting a Fracture Assurance program whereby the requirements to ensure compliance to existing FCPs and to latest edition AS2885 requirements is priority based. The requirements from an ALARP perspective for High Consequence Area (HCA) pipelines extends to obtaining material samples to assess Fracture Toughness where original material certificates do not exist. This Business Case addresses material sampling of a number of HCA pipelines within the VTS to demonstrate compliance to AS2885.1:2018 Fracture Control Requirements and to demonstrate ALARP risk level for a rupture event.

2 Risk Assessment

If a VTS pipeline has a defect through third party interference or a result of material issues as a result of physical or procedural controls failing, a rupture is possible if the defect is of sufficient size (greater than the pipeline Critical Defect Length). The pipeline minimum temperature in general is found downstream of pressure reduction stations and it is in these locations that running brittle or ductile fracture may occur due to inadequate Fracture toughness properties of the pipeline. The consequence of failure in High Consequence areas is normally considered Catastrophic due to the potential for density of population at these locations. The Frequency of occurring is Hypothetical given the specific nature and location of this event.

The below risk rating table details the risk levels for a number of areas:

TABLE 3: RISK RATING

Risk Area	Consequence	Frequency	Residual
Health and Safety	Multiple fatalities of APA employees, contractors or the public	Hypothetical	Intermediate
Environment	Localized impact, substantially rectified within a year or so	Hypothetical	Negligible
Operational Capability	Widespread societal Impact	Hypothetical	Low
People	Some impact on Business unit engagement / rising complaints or breach levels / some staff turnover	Hypothetical	Low
Compliance	Non-compliance with a contractual/legal obligation(s) - results in litigation	Hypothetical	Low
Reputation & Customer	Sustained adverse national: - media articles on APA - viral social media Multiple negative reports by financial analysts	Hypothetical	Low
Financial	$15M - $30M (estimated asset remediation and lost revenue cost)	Hypothetical	Negligible
Residual Risk Rating			Moderate

3 Identification and Assessment of Options

The following demonstrates the need for each category of capital expenditure required for the Fracture Control Compliance assessment

3.1 Identification of Options

3.1.1 Option 1 – Do Nothing

The Do-nothing option would continue operating VTS pipelines without Material Certification demonstrating pipeline compliance with the Fracture Control Plan pipeline material property requirements. By continuing in this manner should an event occur where a running brittle or ductile fracture is possible then arresting of the fracture is an unknown outcome due to insufficient knowledge of the pipeline material properties. On the basis that the Risk level is intermediate and ALARP shall be demonstrated then this would not fulfil this requirement.

3.1.2 Option 2: Fracture Control Plan compliance program

3.1.2.1 Fracture Toughness testing of pipe material

APA has identified pipelines within the VTS which contain High Consequence Areas (HCA) that do not have material certification verifying Fracture Toughness properties. To demonstrate ALARP a number of pipeline material samples need to be obtained from these pipelines via Hot Tapping and cut out of abandoned sections, in addition to these Fracture Testing of stored samples is required to confirm and validate pipeline properties and ensure compliance with the Fracture Control Plans.

- Below is a list of the proposed program of works for this Business Case

TABLE 4: FRACTURE RESISTANCE ASSESSMENT SCHEDULE

Details	Qty	Pipe Dia (mm)	Hot Tap Size	Cost ($)
T1 Morwell to Dandenong Hot Tap Fittings	1	450	450x450	$25,135
T74 Wollert to Wodonga Hot Tap Fittings	2	300	300x300	$34,616
T33 South Melbourne to Brooklyn Hot Tap Fittings	1	750	750x750	$57,336
T120 Quenos Hot Tap Fittings	2	250	250x250	$23,236
T63 Morwell to Tyers Hot Tap Fittings	1	500	500x500	$26,469
T62 Deer Park to Derrimut Hot Tap Fittings	2	150	150x150	$13,744
T75 Wandong to Kyneton Hot Tap Fittings	2	300	300x300	$34,616
Hot Tap Fittings Freight	1			$32,250
T56 Brooklyn to Ballan cut out of abandoned section (Traffic Management, approvals, civil works and cut-out at site etc)	1	200	n/a	$50,000
Project Management	1			$150,000
Design	1			$100,000
Pipeline Integrity Testing	1			$100,000
Civil Works	1			$250,000
In-service Welding	1			$80,000
Hot Tapping	1			$50,000
Construction supervision and Permit Officer	1			$120,000
Material Testing (including T64 stored pipe, T56(1 coupon), T62(2 coupons), T57(1 coupon), T70(3 coupons), T24(2 coupons), T16(2 coupons), T33(2 coupons), T1(2 coupons) including coating removal and reports	1			$150,000
Contingency (10%)				$132,598
Total Cost ($)				**$1,430,000**

3.1.3 Assessment of Options

3.1.3.1 Option 1 Do nothing

Not a credible option as it does not reflect best industry practice for pipeline fracture assurance and will not meet ALARP. The Do-nothing option would result in not demonstrating compliance of the pipelines Fracture Control Plan requirements and risk safety and reliability of supply, i.e. an unsustainable practice.

3.1.3.2 Option 2: Comply with AS2855 Fracture Resistance Assessment requirements (preferred option)

Option 2 involves administering best industry practice by ensuring compliance to existing Fracture Control Plans for each pipeline and retrospective compliance to latest edition AS2885.1:2018 Fracture Control requirements. In addition to the above the risk associated with pipeline rupture as a result of fast tearing brittle or ductile fracture is demonstrated to be ALARP APA can address any areas where the Fracture Control Properties of the pipeline do not meet the requirements of latest edition AS2885.1:2018.

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.

3.1.4 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 Fracture Assurance Program aligns with latest edition AS2885 and meets the ALARP principle.

Efficient
APA has kept samples of pipeline material where possible from projects and maintenance activies on the pipelines for information and potential future testing if required. This will minimise the extent of additional pipe samples required as part of this project.

APA will tender the Civil works, Hot Tapping and material cutting program. The works will be subject to APA procurement policies. The works will be carried out by external contractor who demonstrates specific expertise in completing the civil and mechanical works 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
Ensuring compliance with latest edition AS2885 standard is best industry practice. Physical testing of the pipeline ensures 100% confidence in the ability of existing pipelines to control fast tearing fracture and ensures a Rupture event to be controlled to ALARP.

To achieve the lowest sustainable cost of delivering pipeline services
Sample testing provides sufficient confidence and is representative of the pipeline properties.

3.1.5 Forecast Cost Breakdown

The cost breakdown is based on budget estimates from contractors and experience from similar activities and projects (e.g. pipeline excavation, project management).

TABLE 5: PROJECT COST ESTIMATE,

	CY23-CY27
Internal Labour	$270,000
Materials	$350,000
Other Costs	$80,000
Contracted Labour	$730,000
Total	**$1,430,000**

3.1.5.1.1 Hot Tap Fittings

The Hot Tap Fitting estimate costs were provided by an approved hot tap fitting provider.

3.1.5.1.2 Project Management, Design, Construction Supervision

The costs provided by the SIB Project Team is based on experience in similar project and activities

3.1.5.1.3 Pipeline Integrity testing, Civil Works, In service welding, Hot Tapping

The costs of these activities are based on similar works and activities from previous APA projects.

4 Acronyms

TABLE 6: ACRONYMS

Acronym	Definition/Description
AEMO	Australian Energy Market Operator
AGA	Australian gas association – Type B compliance governing body
ALARP	As Low as Reasonably Practicable
API	American Petroleum Institute – publisher of standards
ESD	Emergency shutdown – control system-initiated shutdown designed to prevent incident escalation if operating parameters are breached
ESV	Energy Safe Victoria
FCP	Fracture Control Plan
HAZOP	Hazard and operability study
HCA	High Consequence Area
RA	Risk Assessment
SMS	Safety Management Study
VTS	Victorian Transmission System

5 Appendix

Appendix A – AS2885 Fracture Resistance Assessment Clause

5.1.1 Fracture resistance assessment

A pipeline that does not have a fracture control plan and associated test data conforming to AS 2885.1-1997 AMDT 1 (2002) shall have a fracture resistance assessment completed and the results contained or referenced in the PIMP.

NOTE 1: Fracture control plans for pipelines designed prior to, or in compliance with, early versions of AS 2885.1, may not meet current requirements, and some early pipelines were constructed with little or no testing (drop weight tear test and Charpy impact test) to establish material toughness properties.

The fracture resistance assessment shall include the following steps:

(a) Develop a retrospective fracture control plan (i.e., determine the requirements as if the pipeline were being designed today) in accordance with AS/NZS 2885.1 as a benchmark for comparison with actual pipeline fracture resistance.

(b) Identify any non-conformance of the constructed pipeline with the sampling and testing regime required for a fracture-control plan and, if data is available, identify any non-conformance with the required fracture-control properties.

NOTE 2 Many older pipelines lack the necessary data to assess conformance to the required fracture properties. It is not intended that sampling and testing be done to acquire data for this purpose. Sampling and testing after the safety assessment required by Item (c) may be useful in providing data to support demonstration that the risk of fracture is ALARP.

(c) If there is any non-conformity, additional data shall be acquired or mitigation measures implemented or both, until it is demonstrated that the threat of fracture is ALARP in accordance with AS/NZS 2885.6.

NOTE 3 Measures that may help achieve conformity include the following:

(a) Reducing MAOP. May be possibly for a portion of a pipeline by installing a pressure reduction STATION.

(b) Reviewing and adjusting conservative design basis parameters such as the minimum design temperature.

(c) Installation of crack arrestors, which are spaced to achieve the required arrest length (noting that crack arrestors will not control brittle fracture).

NOTE 4 Measures that may help demonstrate ALARP include the following:

(a) Testing pipe samples removed from the pipeline to improve knowledge of pipe properties, including Charpy impact testing and drop weight tear testing where possible. Any sampling regime less than that required by a fracture-control plan will reduce the certainty of the conclusions and thus increase the level of risk.

(b) Using test data from similar contemporary pipelines, provided that the ALARP assessment includes validation that the data used is relevant for the pipeline being assessed.

(c) Minimizing events that could initiate fracture from external interference through a high level of physical external interference protection or certain types of procedural protection measures such as intensive patrolling.

(d) Minimizing events that could initiate fracture from growth of time dependant ANOMALIES through enhanced inspection techniques and repairs.

(e) A reduction of the MAOP will also increase the critical defect length and provide a greater margin for rupture from credible external interference events or growth of existing anomalies.

NOTE 5 In locations where other consequences are minimal, a mitigation measure may be to carry stock of spare pipe and fittings and have prepared emergency repair procedures in order to facilitate a rapid return of supply. The consequences of a propagating fracture though may still involve a significant risk to public safety and involve a long-term supply interruption.

A fracture resistance assessment shall be reviewed at intervals not exceeding 5 years to confirm that it remains current for the operating circumstances. The results shall be contained or referenced in the PIMP.