

Final Plan Attachment 8.6 V54 Supporting Information 1

Business Cases

V04 Refurbishment of Dandenong to Crib Point
Pipeline

December 2016

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VICTORIAN NETWORKS

CAPEX

Project Ref/No.	V04		
Project Name	Refurbishment of Dandenong to Crib Point Pipeline	Asset Owner	Envestra
Asset	Transmission Pipeline	Budget Account	Scope Change - CAPEX
Proposed By	Gerald Ramza	Priority Group	Priority 2 - Total Risk Score =76
Reviewed By	Jan Krzys	Step Change Category	
Approved By	Brian Fitzgerald		
Reference Documents			

PROJECT OVERVIEW

The Dandenong to Crib Point pipeline (DCP) was originally constructed in 1966 to carry refinery gas from the BP Crib Point refinery to Dandenong. It was subsequently converted to carry natural gas from Dandenong to Crib Point. The DCP was designed and built to the older American standard USAS B.31.8 code for pressure piping, which does not include improvements that exist in the current Australian standards. It is now 45 years old, and is approaching two-thirds of its design life.

There are no records of weld test data or coating inspections from the time of construction, making it difficult to assess the quality of construction. The pipeline has a number of discovered construction problems including a large number of coating defects. The five-yearly coating fault (DCVG) surveys have discovered a marked increase in the number of faults detected, from 168 faults in the previous survey, to 667, with concerns that the coating has dis-bonded in many places, shielding corrosion.

In order to establish its baseline condition, review its design life, and to maintain the ongoing integrity of the 39km DCP (Licence No 11), it is planned to carry out:

- pipeline alterations to enable inline inspection by intelligent pigging
- intelligent pigging of the pipeline
- pipeline refurbishment works
- clearing of easement vegetation
- upgrade of Cathodic Protection (CP) system.

COSTS AND TIMING

Forecast capex shown in Tables 1 and 2 respectively are based primarily on actual historical costs for similar work. A detailed breakdown of the costs is presented in Attachment A.

The timing for each item is driven mainly by the need to complete engineering survey/design type activities ahead of physically performing work on the pipeline. Forecast costs are also spread out over the five years in line with Envestra's capacity to undertake the work. This is also considered commensurate with the risks involved.

Attachment A also provides more detail in respect to cost justification and timing.

\$'000s (Real 2011 - excluding overheads)							
		2013	2014	2015	2016	2017	Total
1	Contract Services - Project Management & Design	785	185	185	185	185	1525
2	Contract Services - Environmental	500	700	0	0	0	1200
3	Pigging Facilities	0	800	0	0	0	800
4	Pipeline Relocation & Protection	0	0	650	0	0	650
5	Contract Services - Intelligent Pigging	0	0	788	0	0	788
6	Contract Services - Pipe Repair/Abandonment	0	500	501	680	375	2056
7	CP Facilities Refurbishment			247			247
8	Total	1285	2185	2371	865	560	7266

Table 1: Forecast Capex Summary

BACKGROUND

The DCP is the main transmission supply to the Mornington Peninsula region and it augments supply to the Cranbourne network which is situated in one of Melbourne's major growth corridors. The pipeline delivers natural gas to over 120,000 consumers which represents 20% of Envestra's Victorian consumers and delivers 22% of Envestra's Victorian annual demand.

The 300mm nominal diameter DCP was constructed in 1966 to carry refinery gas from the BP Crib Point refinery to Dandenong with the launching and receiving pigging traps orientated in this direction. With the advent of natural gas in the late 1960s the flow was reversed to supply field regulators connected to the pipeline between Dandenong and Crib Point. The Pipeline is now 45 years old and is approaching two-thirds of its design life of 60 years. The pipeline is constructed from API 5L Grade A steel with a coal tar enamel coating and asbestos overwrap and has a Maximum Allowable Operating Pressure (MAOP) of 2760Kpa. The pipeline is known to have a number of faults including a large number of coating defects. Recent five-yearly Direct Current Voltage Gradient (DCVG) coating fault surveys has shown a marked increase in the number of faults detected from 168 faults in the previous survey to 667. Consequently there are concerns that the coating has disbonded in many places and there is a high probability it is shielding corrosion.

A significant portion of the alignment of the pipeline is in a rural/park reserve setting located in easements. Furthermore, the DCP occupies the same easement as the Elgas LPG pipeline from Crib Point to Dandenong (separation distance 1m or less), a white oil pipeline and Envestra's duplicated section of the DCP (it has been necessary to duplicate a section of the pipeline to augment supply to the Mornington Peninsula region and the Cranbourne network). Should there be an incident on any one pipeline, it has the potential to cause collateral damage to one or more of the other pipelines.

The location risk profile of the DCP has changed significantly since it was constructed 45 years ago. Urban encroachment near the pipeline is increasing with the development of industrial land in Dandenong South as well as the development of the Hastings Township at the southern end of the pipeline.

Dandenong South, through which the DCP traverses, is no longer rural but is being developed for warehouses and industrial applications, including the building of an inland port for transfer of freight from Westernport shipping by rail to Lyndhurst. Customs clearance and transport distribution will then take place at Lyndhurst.

A major industrial installation (BP's Crib Point Refinery) has closed. This refinery took oil from tankers at the Crib Point Jetty. As a result of the Refinery closure, the last section of the DCP is unused, including the pig trap (Fig 1). It is proposed to cut back and abandon 1.4km of the 300mm DCP within the refinery.

Fig 1 Pig trap launch of DCP inside abandoned BP refinery Crib Point.



The pipeline undergoes a Potential Survey every 6 months, with an annual report prepared for Energy Safe Victoria (ESV). The surveys thus far have shown that the pipeline is fully protected. There are indications however that the anode beds, part of the CP system, will require replacement in the next Access Arrangement period to ensure the pipeline remains fully protected.

The pipeline integrity management includes 5-yearly DCVG surveys which are showing an increasing trend of coating faults. The last DCVG survey identified 668 faults. Selected fault locations have been excavated and the faults inspected. Some reveal surface corrosion and the results generally indicate that pipeline protection is being compromised due to the coating faults.

Experience on other Envestra tar epoxy coated pipelines of the same vintage has shown a tendency for the coating to dis-bond, creating a corrosion cell that cannot be effectively protected through the CP system and which is difficult to identify through DCVG surveys. It is generally accepted within the industry that measurement of metal loss using an intelligent pig is the most effective means to verify the extent of pipeline defects and corrosion. Intelligent pigging should be carried out at half to two-thirds of design life of a pipeline in order to establish what is required for repairs and/or replacement. Long lead times are required to plan such projects, hence the reason for carrying out intelligent pigging well before the end of a pipeline's design life.

Annual special crossing (e.g. creek and bridge crossings) surveys are also conducted as part of the DCP integrity management program. Several maintenance issues have been identified which require additional operating expenditure to rectify, principally, pipeline cover has been eroded in the vicinity of National Drive, Dandenong South under the Melbourne Water drainage course (Fig 2). The top of the pipeline is protected from water scouring by a concrete slab, which has 100mm clearance from the pipeline.

Fig 2 Undermined scouring protection slab Melbourne Water Course National Drive



Recent heavy rains have undermined the pipeline which is at the edge of the slab and it is physically possible to touch the pipeline in the water from the top of the slab. Top of slab to top of pipe is approximately 300mm. Checks of the coating have shown no coating damage. However the pipeline will require lowering under this water course by approximately 1.5m and will require custom designed concrete channelling to provide protection when flash flooding occurs.

The line valve at Graydens Road, Hastings is located adjacent to the railway easement near Kanowna St which is an unmade road from which the pipeline can be accessed. This road has been graded and reformed a number of times such that its profile has been distorted and this causes flash flooding of the valve pit during heavy rain. Works are required in conjunction with the road authority to reconfigure the valve pit and its drainage protection. Sandblasting of the pipe-work and recoating of the valve installation is also necessary.

Fig 3: Graydens Road line valve installation



Sections of the DCP are located in environmentally sensitive areas where vegetation clearance over pipeline easements has been problematic, in particular a section of pipeline traversing the Warringine Creek reserves in Hastings and the Bittern Coastal wet lands. Refer to Figure 4 below.

Figure 4: Vegetation growth - Warringine Reserve



The Victorian Government's "Victoria's Native Vegetation Management - A Framework For Action" mandates that any vegetation losses must be balanced by commensurate revegetation elsewhere. This will add significant cost to clearing the DCP easements based on recent estimates of \$1m in net gain offsets for a proposed 7 km duplication of the DCP. Consequently, easement clearance has been severely constrained during the life of the DCP.

The existing CP anode beds are over 25 years old and are nearing the end of their effective design life. Unless these are replaced there is a risk that the pipeline may not be adequately protected in the future, exacerbating the risk of external corrosion.

In order to comply with the requirements of AS 2885.3 (Pipelines - Gas and liquid Petroleum, Operation and Maintenance), AS 4645.2 (Gas Distribution Network Management) and AS 2832.1 Cathodic Protection of Metals Part 1: Pipes and Cables, CP levels on the DCP must be maintained to ensure the integrity of the pipeline. Envestra's Safety and Operating Plan, as approved by ESV, also requires that Envestra's transmission and distribution pipelines are adequately protected at all times.

KEY ASSUMPTIONS / DRIVERS

There are a number of pipeline integrity issues, as outlined above, that require addressing by a coordinated managed approach to ensure the long term integrity of the pipeline and to reduce operating risks to a level as low as reasonably practicable.

With a DCP replacement cost estimated to be of the order of \$60M, maximising the life of the existing pipeline is paramount.

Any pipeline failure or down rating of the MAOP would significantly impact the supply of gas to over 120,000 consumers located in the Mornington Peninsula region and the Cranbourne network.

The following scope of work is considered prudent over the next Access Arrangement period:

- Modify the pipeline to allow intelligent pigging (the current orientation of the launching and receiving pigging traps and the design of the 200mm tapping installed in 1970 to supply Esso at Long Island Point prevent intelligent pigging)
- Verify metal loss, by intelligent pigging, across the full length of the pipeline
- Vegetation clearance of pipeline easements to ensure accessibility for coating surveys, maintenance and repair
- Repair pipe and coating defects
- Relocate sections of the pipeline and facilities deemed at risk from water course damage.

OPTIONS CONSIDERED

Three options were considered:

1. Replacement of the asset based on DCP duplication costs would require an estimated \$60m expenditure, with \$52m to relay the pipeline, and another \$8m to effect connections to the existing transmission pipelines on the Peninsula, and field regulators currently off-taking from the DCP.
2. Replacement of coating only and defect repair, as discovered from a coating strip for full length of pipeline. The cost of complete recoating would be similar to relaying of pipeline less pipe cost and welding, approximately \$40m.
3. A targeted capital works program for rehabilitation of the pipeline in conjunction with intelligent pigging at a cost of \$7.3m is the most viable solution to resolving / establishing design life, for the 45 year old pipeline now past its half-life, and affords the highest level of protection as is reasonably practical, given the circumstances of this particular pipeline.

Option 3 has been adopted in order to establish the baseline condition of the DCP and to maintain the ongoing integrity of the pipeline. This is the preferred option and is consistent with Envestra's obligation to act prudently and the timeframe is commensurate with the risks and level of expenditure involved. The forecast capex is based on a use of a mix of internal and external resources.

Consideration was given to an alternative scenario for Option 3 of deferring the internal pigging and some of the defect rectification/refurbishment work to the following Access Arrangement period. This is not considered prudent given the known condition of the DCP as described previously. Given the significance of this pipeline Envestra is seeking to establish its integrity on a "as soon possible basis" to allow any longer term strategies for pipeline refurbishment, replacement or abandonment to be included in the subsequent Access Arrangement period. Envestra considers it has a regulatory obligation to establish the baseline condition of the DCP within the next five years in order to implement strategies for future pipeline enhancement replacement or abandonment if required.

This alternative was not costed for these reasons.

RISK ASSESSMENT

A risk assessment has been carried out using APA's established evaluation criteria (detailed in section 2.8 of the Asset Management Plan) to produce an estimated level of risk and to rank and prioritise the risk based on APA's established risk management and control criteria.

The principal risk is related to a major failure of the pipeline as a result of undetected corrosion. The stress levels within this pipeline are such that a catastrophic failure is unlikely; however a significant gas release could result in major disruption of supply to over 100,000 industry and residential consumers. An emergency repair would require isolation of a pipeline section and depending on the location and time of year, would affect several thousand consumers, including major industries and Peninsula hospitals.

The location risk profile is changing from predominantly rural to a semi urbanized environment such that failure of the pipeline could potentially impact the safety of residents in close proximity.

In the event of a significant failure of the DCP there is a risk of consequential damage to 3rd party pipeline assets, co-located within the same easement.

The untreated risk associated with the Dandenong to Crib Point transmission network has been assessed as "High" and has been assigned Priority 2. The risk assessment and estimated risk levels for this project have been assessed and the results are detailed in Attachment B.

JUSTIFICATION

Consistent with the requirements of rule 79 of the National Gas Rules, Envestra considers that the capital expenditure being sought for this project is:

- *Prudent* - the expenditure is necessary in order to ensure that the ongoing integrity of the DCP is maintained and to ensure that Envestra meets its Licence obligations;
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- *Efficient* - Envestra considers this proposal as the only practical and effective option. Engineering assessments and design will be carried out by internal staff and field work will be carried out by external contractors based on competitively tendered rates;
- *Consistent with accepted and good industry practice* - Envestra adheres to the requirements of AS 2885.3 Pipelines- Gas & Liquid Petroleum, Part 3: Operations and Maintenance which, in addition to being a regulatory Standard, also reflects accepted and good industry practice;
- *Necessary to achieve the lowest sustainable cost of delivering pipeline services* - The project is considered necessary for safety reasons, i.e. to maintain the ongoing integrity of the DCP.

For the reasons outlined above, Envestra believes forecast capital expenditure is prudent and efficient and meets the requirements of Rule 79(1)(a).

Consistent with the requirements of Rules 79(2)(c)(i), 79(2)(c)(ii) and 79(2)(c)(iii) of the National Gas Rules, Envestra considers that the proposed capital expenditure required for refurbishing and carrying out other works associated with the DCP is justified as being necessary so as to:

- *Maintain and improve the safety of services* - to maintain security of supply.
- *Maintain the integrity of services* - to maintain the integrity of the DCP so that it can continue to operate with a MAOP of 2,760kPa.
- *Comply with a regulatory obligation or requirement* - Envestra has a Licence obligation to operate, maintain and review the DCP such that it "remains fit for purpose" in accordance with AS 2885.3 Pipelines- Gas & Liquid Petroleum, Section 3: Pipeline Integrity Management.

CONSEQUENCES OF NOT PROCEEDING

If this project is not undertaken, then Envestra will be exposed to:

- The risks of a major failure of a major supply pipeline affecting supply to several thousand consumers.
 - Potential consequential damage to 3rd party pipelines occupying a common easement.
 - Inability to effectively develop a long term strategy to optimise the life and operating costs of a significant asset. The replacement cost of this pipeline is circa \$60M.
 - Inability to properly maintain the DCP and respond effectively to an emergency pipeline leak caused by third party damage or as a result of easement vegetation.
 - Increasing maintenance costs as result of reactive repairs to the pipeline.
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ATTACHMENT A - FORECAST CAPEX

Table 2: Forecast Expenditure Cost Basis

	Description	Total \$K	Basis of costing
1	Complete engineering survey of pipeline for piggability, and recast drawings by survey to reflect development along the pipeline easements. Complete front end engineering design of refurbishment, approvals and project & environmental management plans.	500	Estimates received from Gasnet for project & environmental management plans and approvals for the third stage duplication of the existing DCP have been quoted at \$439k for a 7.1km length of pipeline. Therefore not considered unreasonable to allow \$500k for resurvey and design reconfiguration of 39km of pipeline.
2	Risk study and emergency contingency planning in conjunction with Elgas, for pigging operation, progressive alterations and any repairs adjacent to Elgas facilities.	100	Blue scope strip cold strip mill MAOP review quotation GUD \$80k, have allowed a similar amount for this risk study plus an additional amount of \$20k for costs associated with Elgas participation and ongoing costs over five years for the length of refurbishment project.
3	Clear easement vegetation including provision for vegetation offset costs Warringine Park & Bittern Coastal Wet Lands. Resign pipeline route as required	1200	First 20km of the existing Dandenong to Crib Point pipeline is in the process of being duplicated and will be duplicated to Robinsons Rd. No duplication is planned beyond this point. Within this duplication 7km of pipeline easement required vegetation net gain costs of \$1M, It is assumed that a similar amount has to be allowed for in the balance of 19km not yet cleared. This is a conservative estimate as the pipeline traverses Bittern Coastal Wet lands reserve and the Warringine Creek Reserves.
4	Cut back and abandon 1.4km of 300mm TP pipeline within refinery.	200	Typical cost for small alteration allows for stopple fittings \$75k,excavation labour, lamination testing, x ray welding labour, non-destructive testing of welds and certification prior to hot tap , degassing of abandoned pipe, and some removal costs
5	Intelligent pigging of Pipeline	788	Pipeline pigging costs based on actual costs to pig ring main 1/3 share \$398k, ring main 450mm x 74km cost \$1.18m, DCP line 300mm x 39km. Assume final pigging costs 2/3rds of inner ring main pigging, \$788k
6	Repair metal loss faults detected by pigging of pipeline ,examine and recondition all air to ground interfaces of line valve equalisation bypass upstands, and check recoat all valves assemblies	381	Repair metal loss faults detected from the pigging survey, 668 coating faults assume intelligent pig will find 1% of coating faults will have metal loss requiring repair @ \$30k per repair allowance \$201k, and assumption is all wall loss not severe and repairable by clock-spring. An allowance of \$180k has been made for recheck and coat 24 valves assemblies and inspection and repair of six regulator installations inlet and outlet pipe-work, allowance \$5k per excavation & coating repair.
7	Repair Pipeline coating faults, and recoat pipeline where required.	975	Recoat the pipeline, over sections of where coating identified as being at the end of its useful life, allow 10% recoating, 39km @\$250 per metre. Recent experience on recoating 200mm transmission main licence 49 Dandenong Frankston Rd cost \$325K for 500m.
8	Repair special crossing defects (allow for two major defects to be repaired)	400	Same comments as item 4 (two defects have thus far been found on this pipeline requiring repairs)

	Description	Total \$K	Basis of costing
9	Recondition line valve installation at Graydens Rd and install drainage flood protection	100	Allowance depends on requirements of council and final drainage design. Is a nominal amount for design drawings council approvals, excavation and removal of valve concrete enclosure recoating of pipework and recast of new concrete with possibly additional roadworks.
10	Engage Contract Project Manager (Pipeline Engineer) for duration of project. Required for design basis, design life rating, ESV sign-off, and project liaison construction and remediation management for five years.	925	Allow \$185k per annum for five years, cost \$925k
11	Relocate launching and receiving pig traps & modify for IP.	200	Basis of estimate is recent experience in altering the 200mm transmission pipeline at Robinsons Rd for Peninsula Link Road works. Cost of project \$401k, \$600k has been allowed for item 2, it is anticipated that bypass works will be required to provide continuous supply of gas to Esso at Long Island Point, in order to install pigging bars which will allow the pigs to pass the branch line connection point.
12	Complete all identified alterations required as a result of engineering survey to enable intelligent pigging of the pipeline.	600	
13	Lower Pipeline at National Drive water course	400	
14	Refurbish & upgrade all cathodic protection beds	247	Allow three units to be replaced \$53k each unit, one additional unit for additional protection, and one unit to be partially replaced at \$38k per unit.
15	New concrete scouring protection works (National Drive)	250	Nominal amount cost dependant on design advice and requirements of Melbourne Water
16	Total Capital Expenditure	7266	Note to put the total proposed project cost in perspective current pipeline in 39km long, to replace the pipeline would be approx. \$1540 per metre, total cost \$60 million.

Table 3: Capital Expenditure Cost Schedule

Proposed timing of the works essentially reflects the envisaged sequence in which the tasks/activities will be performed, but their maybe some variation when the engineering design is completed

		\$'000s (Real 2011 - excluding overheads)					
		2013	2014	2015	2016	2017	Total
1	Complete engineering survey of pipeline for piggability, and recast drawings by survey to reflect development along the pipeline easements. Complete front end engineering design of refurbishment, approvals and project & environmental management plans.	500	0	0	0	0	500
2	Risk study and emergency contingency planning in conjunction with Elgas, for pigging operation adjacent to Elgas facilities.	100	0	0	0	0	100
3	Clear easement vegetation including provision for vegetation offset costs Warringine Park & Bittern Coastal Wet Lands. Resign pipeline route as required	500	700	0	0	0	1200
4	Cut back and abandon 1.4km of 300mm TP pipeline within refinery.		200				200
5	Relocate launching and receiving pig traps & modify for Intelligent Pigging.	0	200	0	0	0	200
6	Complete all alterations to enable intelligent pigging of the pipeline.	0	600	0	0	0	600
7	Lower Pipeline at National Drive water course	0	0	400	0	0	400
8	Intelligent pigging of Pipeline	0	0	788	0	0	788
9	Repair metal loss faults detected by pigging of pipeline and examine and recondition all air to ground interfaces of line valve equalisation bypass upstands.	0	0	201	180	0	381
10	Refurbish & upgrade all cathodic protection beds	0	0	247	0	0	247
11	Repair Pipeline coating faults, and recoat pipeline where required.	0	200	300	300	175	975
12	Repair special crossing defects (allow two major defects to be repaired)	0	0	0	200	200	400
13	Recondition line valve installation at Graydens Rd and install drainage flood protection	0	100	0	0	0	100
14	New concrete scouring protection works (National Drive)	0	0	250	0	0	250
15	Project Manager (Pipeline Engineer) for design basis, design life rating, ESV sign-off and remediation management.	185	185	185	185	185	925
16	Total	1285	2185	2371	865	560	7266

ATTACHMENT B – DANDENONG TO CRIB PT TRANSMISSION NETWORK RISK MITIGATION ANALYSIS

		Health & Safety	Financial Impact	Customer & Business Interruption	Environment	Compliance & Legal	Reputation	
Risk Untreated	Likelihood	<i>Unlikely</i>	<i>Unlikely</i>	<i>Unlikely</i>	<i>Possible</i>	<i>Possible</i>	<i>Possible</i>	
	Consequence	<i>Major</i>	<i>Major</i>	<i>Major</i>	<i>Moderate</i>	<i>Severe</i>	<i>Severe</i>	
	Risk Level	<i>High</i> 14	<i>High</i> 14	<i>High</i> 14	<i>Moderate</i> 08	<i>High</i> 13	<i>High</i> 13	76
Residual Risk	Likelihood	<i>Rare</i>	<i>Rare</i>	<i>Rare</i>	<i>Rare</i>	<i>Rare</i>	<i>Rare</i>	
	Consequence	<i>Major</i>	<i>Major</i>	<i>Major</i>	<i>Moderate</i>	<i>Severe</i>	<i>Severe</i>	
	Risk Level	<i>Moderate</i> 10	<i>Moderate</i> 10	<i>Moderate</i> 10	<i>Low</i> 03	<i>Moderate</i> 06	<i>Moderate</i> 06	45

Priority	Priority Description
Priority 1	Any project, where Risk Level of at least one risk area falls into Extreme must be included in Priority 1. These projects should be regarded as non-discretionary, as their justification is to mitigate the risk level that is not acceptable to APA.
Priority 2	Any project, where Risk Level of at least one risk area falls into High must be included in Priority 2. The non inclusion of these projects may expose APA, or third party asset owner to potential short and long-term business damage.
Priority 3	Any project, where Risk Level of at least one risk area falls into Moderate must be included in Priority 3. The non inclusion of these projects may affect reliability of assets; as well it may affect operating efficiency and compliance.
Priority 4	Any project, where Risk Level of at least one risk area falls into Low must be included in Priority 4. The non inclusion of these projects may affect opportunity for overall company risk reduction and operating efficiencies.

This project is rated as a priority 2 – High