Evoenergy

Watson Pressure Limiting Station Project

Options Analysis

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1. EXECUTIVE SUMMARY

1.1 PROJECT AND KEY DRIVERS

The Canberra Primary Main (**CPM**) is the major pipeline for the supply of natural gas to the secondary pressure distribution network in the Canberra region. It is approximately 42.8km long and receives gas from two supply sources: Fyshwick Trunk Receiving Station (**TRS**) and Watson Custody Transfer Station (**CTS**).

Recently, three new child care centres were developed in the Throsby area adjacent to the Canberra Primary Main, resulting in the land use change along the Watson to Gungahlin section of the pipeline which runs along Horse Park Drive; the section is now considered as Sensitive location class.

A technical assessment[1] was carried out in October 2019 to review the current controls to determine if the pipeline risk profile remains acceptable. The technical assessment concluded that although the existing physical protection for the pipeline is adequate and effective, there is still a credible risk of pipeline rupture in an 'all controls fail' scenario. With two child care centres within the pipeline's 12.6kW/m^2 thermal radiation contour radius[2], pipeline rupture may result in catastrophic consequence; thus, further risk reduction should be implemented where reasonably practicable.

The primary driver for this project is the safety of the general public, particularly the children in the child care centres in close proximity to the Canberra Primary Main. The secondary driver is to comply with AS/NZS 2885's requirement for pipeline in Sensitive location class to be 'No Rupture' [3, 4].

Both the project drivers can be addressed by lowering the operating pressure of the Canberra Primary Main. Lowering the maximum operating pressure (**MOP**) of the CPM from the current 6,200kPag to 3,500kPag will reduce the pipeline's 12.6kW/m^2 thermal radiation contour radius such that all the child care centres are outside of the radius. It will also reduce the hoop stress of the CPM to less than 30% of the Specified Minimum Yield Strength (**SMYS**), making it a 'No-Rupture' pipeline[5].

In order to reduce the MOP of the Canberra Primary Main to 3,500kPag, a pressure limiting station (**PLS**) is required at Watson to ensure that gas entering the CPM from Watson CTS does not exceed 3,500kPag. The pressure of the gas entering the CPM from Fyshwick can be regulated by the Fyshwick TRS.

This Options Analysis will address the options for installing a pressure limiting station (**PLS**) downstream of Watson CTS to reduce the maximum operating pressure of the Canberra Primary Main from 6,200kPag to 3,500kPag. This will reduce the overall risk rating of pipeline failure impact on public safety from INTERMEDIATE to LOW[6].

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1 GAS-4100-RP-IN-007 Review of Pipeline Existing Controls due to Sensitive Development in Throsby Area Rev. 0

2 A thermal radiation level of 12.6kW/m^2 represents the threshold for fatality for normally clothed people, resulting in third degree burns after 30 seconds exposure. Source: AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management APPENDIX B Section B1

3 AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction Section 4 Clause 4.9 Provisions for High Consequence Areas

4 AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management Section 5 Clause 5.5.1 Periodical Operational Review

5 AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction Section 4 Clause 4.9.2 No Rupture

6 See APPENDIX A Risk Assessment Summary

1.2 CREDIBLE OPTIONS

The credible options and associated estimated costs for this project is presented in Table 1 below.

Table 1. Options for Project

Option	Option Name	Description	CAPEX ($000's, Real 2020)
1	Maintain Status Quo	Do Nothing.	$0
2	Install a pressure limiting station with two runs – full redundancy at design maximum load	Pressure Limiting Station with two identical runs; each run will be capable of supplying the design maximum load of 160,000scmh. Full redundancy. DN300 pipework and equipment, with the exception of DN200 regulators.	$3,290
3	Install a pressure limiting station with two runs – no redundancy at design maximum load **(Recommended Option)**	Pressure Limiting Station with two identical runs; each run capable of supplying 80,000scmh. Both runs will be required to supply the design maximum load of 160,000scmh. No redundancy. Provision will be provided for a third run. i.e. inlet and outlet header in place. DN300 inlet and outlet header, DN250 pipework and equipment upstream of filter, DN200 pipework and equipment downstream of filter, with the exception of DN150 regulators.	$2,906

1.3 RECOMMENDATION

The recommended option is Option 3 – Install a pressure limiting station with two runs (with provision for a third run) with no redundancy at maximum load. Each run will be capable of supplying 80,000scmh at the design minimum inlet pressure of 2,800kPag. Historical data from 01 January 2016 to 02 March 2020 (see Appendix C) shows that the flow through Watson CTS exceeded 80,000scmh for less than 0.5 per cent of the time, with the maximum flow being 143,449scmh. Therefore, based on historical data, the recommended pressure limiting station will have full redundancy for over 99.5 per cent of the time.

If the maximum load increases in the future and the pressure limiting station is frequently operating on both runs, a third run can be installed to provide redundancy.

This recommended option has a forecasted cost of $2,906k over the RY2022-2024 period.

Implementation of this recommendation will eliminate the risk of pipeline rupture, therefore reducing the overall risk rating of pipeline failure impact on public safety from INTERMEDIATE to LOW (See Appendix A).

1.4 NATIONAL GAS RULES

The implementation of the project adheres to the new capital expenditure criteria rules 79 (1) and 79(2)(c)(i) & (iii).

The proposed solution is consistent with Rule 79 (1) of the National Gas Rule as per:

- Prudent – Three options have been considered. The selected option reduces the overall residual risk associated with pipeline failure from INTERMEDIATE to LOW. This is consistent with what would be expected of a prudent operator.
- Efficient – The cost estimates were developed from actual costs of a similar project that underwent a competitive tender process.
- The proposed solution is necessary to reduce the consequence of a pipeline failure event to protect the safety of the general public and in compliance with regulatory obligations.

The project is also consistent with rule 79 (2)(c), because it is necessary to:

- Maintain and improve the safety of services (79 (2)(c)(i)) by eliminating the risk of pipeline rupture and reducing the safety consequence in a pipeline failure event.
- Comply with a regulatory obligation (79 (2)(c)(iii)) – AS/NZS 2885.1[7] requires pipeline in a Sensitive location to be 'No-Rupture'.

[7] AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction Section 4.9 Provisions for High Consequence Areas

2. PROJECT BACKGROUND AND KEY DRIVERS

2.1 PROJECT BACKGROUND

The Canberra Primary Main (**CPM**), the major pipeline for supply of natural gas to the secondary distribution network in the Canberra region, is owned by Evoenergy and managed by Jemena Gas Networks (**JGN**). The CPM is approximately 42.8km long and with maximum allowable operating pressure (**MOP**) of 6,200kPag.

The Canberra Primary Main receives gas from two sources:

1. Gas from the Victorian gas fields (Longford): Natural gas is transported from Longford gas fields to Hoskinstown CTS via the Eastern Gas Pipeline (**EGP**). From Hoskinstown CTS, the gas flows through the Hoskinstown to Fyshwick Pipeline (Licence 29) to Fyshwick TRS, which feed into the Canberra Primary Main. Both Hoskinstown CTS and Fyshwick TRS have pressure control capabilities.

2. Gas from the South Australian gas fields (Moomba): Natural gas is transported from Moomba gas fields and other interconnecting pipelines from Queensland and Victoria via the APA Moomba to Sydney Pipeline (**MSP**) and the Dalton to Watson Lateral to the Watson CTS, which feeds into the Canberra Primary Main. There are no pressure control facilities between the MSP and the CPM. The gas enters the CPM at pressures between 2,800kPag and 6,200kPag.

Recently, three child care centres have been developed in the Throsby area adjacent to Horse Park Drive, impacting the Watson to Gungahlin section of the Canberra Primary Main. The location of the child care centres in relation to the Canberra Primary Main is shown in Figure 1.

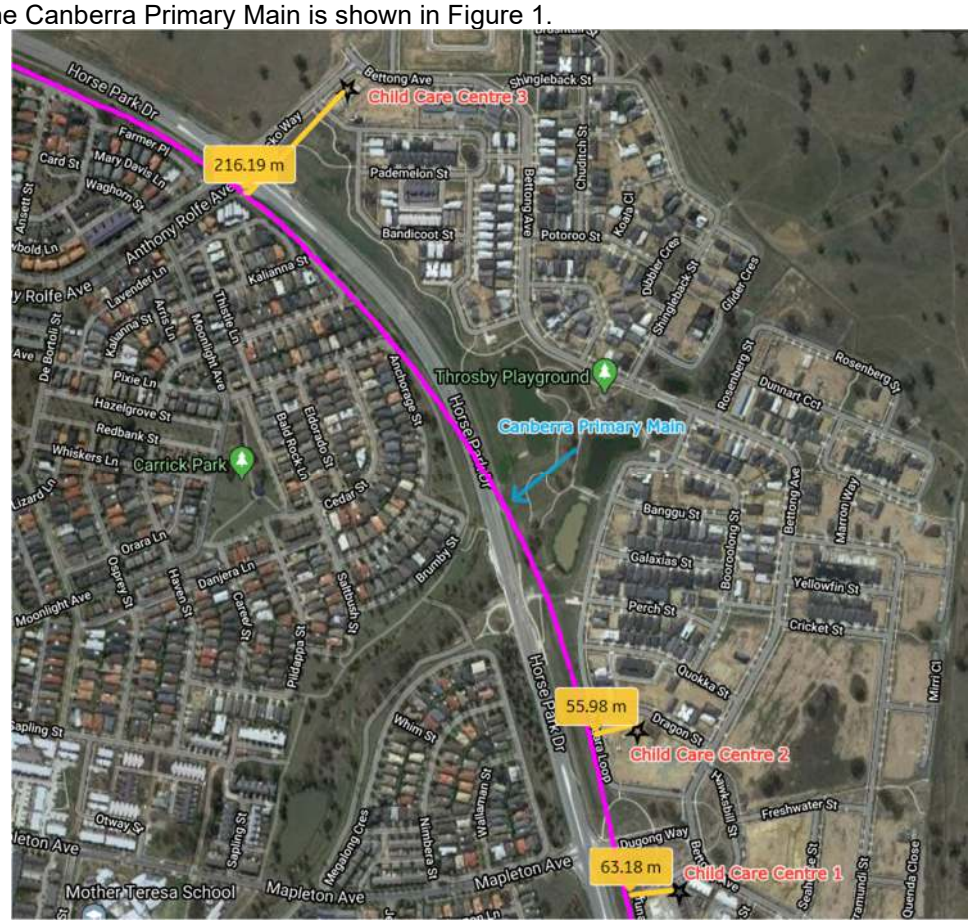

Figure 1: Location of Child Care Centres adjacent to Canberra Primary Main

The location class of this section of the Canberra Primary Main is now considered Sensitive. A technical assessment[8] was carried out in October 2019 to review the current controls to determine if the pipeline risk profile remains acceptable. The technical assessment concluded that the existing depth of cover and mass pour concrete/concrete slab provide adequate and effective physical protection to the pipeline from being punctured by excavators (up to 30t with tiger teeth) and vertical auger threats. However, in an 'all controls fail' scenario, pipeline rupture is a credible risk at the current MOP 0f 6,200kPag, with two of the three child care centres within the pipeline's 12.6kW/m^2 thermal radiation contour radius[9].

2.2 IDENTIFIED NEED

Table 2 shows the thermal radiation contour radius for 4.7kW/m^2 and 12.6kW/m^2 for full bore rupture at the current pipeline MOP of 6,200kPag. A thermal radiation level of 4.7kW/m^2 will cause injury, at least second degree burns, after 30 seconds' exposure. A thermal radiation level of 12.6kW/m^2 represents the threshold for fatality for normally clothed people, resulting in third degree burns after 30 seconds exposure[10].

Table 2: Thermal Radiation Contour Radius for Full Bore Rupture of Pipeline

Thermal Radiation Intensity	Radius Distance
12.6kW/m^2	119m
4.7kW/m^2	195m

The three new child care centres in the Throsby area adjacent to the Canberra Primary Main are located 56m, 63m and 216m away from the pipeline[11], placing two of the three child care centres within the 12.6kW/m^2 thermal radiation contour radius in the event of a pipeline rupture.

The consequence of a pipeline rupture adjacent to the child care centre can be catastrophic, resulting in multiple fatalities. Therefore, further risk reduction should be implemented where reasonably practicable. Since thermal radiation contour radius is dependent on the pipeline diameter and operating pressure, reducing the pipeline operating pressure can reduce the consequence of pipeline failure.

2.3 PROJECT DRIVERS AND OBLIGATIONS

The key drivers for this Watson Pressure Limiting Station Project are:

a. Safety: Child care centres are located within the 12.6kW/m^2 thermal radiation contour radius. Although there are adequate physical controls in place, there remains an INTERMEDIATE risk of pipeline rupture, ignition of gas release, resulting in multiple fatalities.

8 GAS-4100-RP-IN-007 Review of Pipeline Existing Controls due to Sensitive Development in Throsby Area Rev. 0

9 A thermal radiation level of 12.6kW/m^2 represents the threshold for fatality for normally clothed people, resulting in third degree burns after 30 seconds exposure. Source: AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management APPENDIX B Section B1

10 AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management APPENDIX B Clause B1

11 Measurements are taken from JGN GIS.

b. Compliance: With location class of High Density (T2) Sensitive (S), the Watson to Gungahlin section of the Canberra Primary Main which runs along the Horse Park Drive is required to comply with AS/NZS 2885's requirement for 'No-Rupture' [12, 13].

- ***AS/NZS 2885.1 - 2018 Section 4 Clause 4.9.2 No Rupture***

In Residential (T1), High Density (T2), Industrial (I), Sensitive (S) and Environmental (E) location classes and in Heavy Industrial (HI) location class (where pipeline failure would create potential for consequence escalation), and in Crowd (C) location class (where determined by the Safety Management Study), the pipeline shall be designed such that RUPTURE is not a credible failure mode. For the purpose of this standard, this shall be achieved either by one of the following:

(a) The Hoop Stress at MAOP shall not exceed 30% of SMYS.

(b) The Hoop Stress at MAOP shall be selected such that the credible defect length is not less than 150% of the axial length of the largest hole produced by the THREAT identified in that location.

- ***AS/NZS 2885.6 - 2018 Section 5 Clause 5.5.1 Periodic Operational Review***

…..All pipelines in high-consequence areas shall be assessed for conformance with the requirements of AS/NZS 2885.1 for NO-RUPTURE and maximum energy release rate. Where the pipeline does not comply with one or both of these requirements, a formal ALARP assessment shall be done. Additional control measures shall be applied until it is demonstrated that the risk associated with RUPTURE is ALARP….

2.4 CURRENT STATUS OF ASSET

2.4.1 PIPELINE PARAMETERS

The basic pipeline parameter of Watson to Gungahlin section of the Canberra Primary Main is shown in Table 3.

Table 3: Pipeline Parameters

Parameter	Value
Nominal Diameter	DN250 (OD 273.1mm)
Wall Thickness	7.11mm
Commissioned Year	1997
Pipe Grade	API 5L X42
Pipeline Length	7.20km
Design Maximum Allowable Operating Pressure (**MAOP**)	6.895MPag

[12] AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction Section 4 Clause 4.9 Provisions for High Consequence Areas

[13] AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management Section 5, Clause 5.5.1 Periodical Operational Review

Parameter	Value
Maximum Operating Pressure (MOP)	6.20MPag
Specified Minimum Yield Strength (**SMYS**)	290MPa
Hoop Stress at MOP	119MPa
Hoop Stress as % of SMYS	41%
Pipe Coating	High Density Polyethylene (Yellow Jacket)
Field Joint Coating	Heat shrink sleeves
Depth of Cover	1200mm (600mm when in rock)
Critical Defect Length	164mm

The criteria for 'No Rupture'[14] are: hoop stress less than 30% SMYS **or** critical defect length more than 150% of largest hole length. From Table 3, the hoop stress at current MOP of 6,200kPag is greater than 30% of SMYS. Therefore to meet 'No Rupture' requirement, the maximum credible threat can create a hole of no more than 109mm (66.67%) of the critical defect length; however, excavators equal to 35 tonne and above may cause a hole length of 110mm or more.

Since the Watson to Gungahlin section of the Canberra Primary Main does not meet either criteria for 'No-Rupture', pipeline rupture is a credible failure mode.

2.4.2 THERMAL RADIATION CONTOUR RADIUS

The thermal radiation contour radius is the distance at which the thermal radiation from ignited gas has a certain intensity. A thermal radiation level of 4.7kW/m^2 will cause injury, at least second degree burns, after 30 seconds' exposure. A thermal radiation level of 12.6kW/m^2 represents the threshold for fatality for normally clothed people, resulting in third degree burns after 30 seconds exposure[15].

The thermal radiation contour radius (at MOP of 6,200kPag) caused by machinery which may be operational in close proximity to the Watson to Gungahlin section of the Canberra Primary Main are shown in Table 4.

Table 4: Thermal Radiation Contour Radius for 6,200kPag

Machinery	Maximum Hole Length	12.6 kW/m^2 Thermal Radiation Contour Radius	4.7 kW/m^2 Thermal Radiation Contour Radius
Vertical Auger	50mm	28m	45m
Horizontal Directional Drill (**HDD**)	50mm	28m	45m

[14] AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction Section 4 Clause 4.9.2

[15] AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management APPENDIX B Clause B1

Machinery	Maximum Hole Length	12.6 kW/m^2 Thermal Radiation Contour Radius	4.7 kW/m^2 Thermal Radiation Contour Radius
10 tonne Excavator	70mm	39m	64m
15 tonne Excavator	85mm	47m	77m
20 tonne Excavator	95mm	53m	86m
25 tonne Excavator	100mm	56m	91m
35 tonne Excavator	110mm	61m	100m
55 tonne excavator	125mm	70m	114m
Full Bore Rupture		119m	195m

2.4.3 PIPELINE FAILURE IMPACT ON CHILD CARE CENTRES

The three new child care centres are situated approximately 56m, 63m and 216m away from the Watson to Gungahlin section of the Canberra Primary Main. (See Figure 1)

Vertical auger and HDD impact: No child care centres are within either the 12.6kW/m^2 or 4.7kW/m^2 thermal radiation contour radius.

10, 15 and 20 tonne excavator impact: No child care centre within 12.6kW/m^2 thermal radiation contour radius.Two child care centre within 4.7kW/m^2 thermal radiation contour radius.

25 and 35 tonne excavator impact: One child care centre within 12.6kW/m^2 thermal radiation contour radius. One child care centre within 4.7kW/m^2 thermal radiation contour radius.

55 tonne excavator impact: Two child care centre within 12.6kW/m^2 thermal radiation contour radius.

Full Bore Rupture: Two child care centre within 12.6kW/m^2 thermal radiation contour radius.

2.5 REDUCE CANBERRA PRIMARY MAIN MAXIMUM OPERATING PRESSURE

Jemena Capacity Planning Distribution advised that Canberra Primary Main is required to operate at 3,500kPag or above to ensure security of gas supply to the Canberra network. Therefore, the Canberra Primary Main MOP can be reduced from 6,200kPag to 3,500kPag to minimise the impact of a pipeline failure without compromising security of gas supply.

2.5.1 PIPELINE PARAMETERS

The revised pipeline parameters of Watson to Gungahlin section of the Canberra Primary Main at reduced maximum operating pressure of 3,500kPag is shown in Table 5.

Table 5: Revised Pipeline Parameters at 3,500kPag

Parameter	Value
Nominal Diameter	DN 250 (OD 273.1mm)
Wall Thickness	7.11mm
MOP	3.50MPag
SMYS	290MPa
Hoop Stress at MOP	67.2MPa
Hoop Stress as % of SMYS	23.2%

By lowering the MOP of the Watson to Gungahlin section of the Canberra Primary Main, the hoop stress of the pipeline is less than 30% of SMYS, therefore, rupture will not be a credible failure mode.

2.5.2 THERMAL RADIATION CONTOUR RADIUS

Thermal radiation contour radius is dependent on the pipeline diameter and operating pressure, thus lowering the maximum operating pressure of the Canberra Primary Main will reduce the thermal radiation contour radius in the event of a pipeline failure.

The thermal radiation contour radius at MOP of 3,500kPag caused by machinery which may be operational in close proximity to the Watson to Gungahlin section of the Canberra Primary Main are shown in Table 6.

Table 6: Thermal Radiation Contour Radius for 3,500kPag

Machinery	Maximum Hole Length	12.6 kW/m^2 Thermal Radiation Contour Radius	4.7 kW/m^2 Thermal Radiation Contour Radius
Vertical Auger	50mm	21m	35m
Horizontal Directional Drill (**HDD**)	50mm	21m	35m
10 tonne Excavator	70mm	30m	49m
15 tonne Excavator	85mm	36m	59m
20 tonne Excavator	95mm	40m	66m
25 tonne Excavator	100mm	43m	70m
35 tonne Excavator	110mm	47m	77m
55 tonne excavator	125mm	53m	87m

Machinery	Maximum Hole Length	12.6 kW/m^2 Thermal Radiation Contour Radius	4.7 kW/m^2 Thermal Radiation Contour Radius
Full Bore Rupture		No Rupture	No Rupture

2.5.3 PIPELINE FAILURE IMPACT ON CHILD CARE CENTRES

Vertical auger and HDD impact: No child care centres are within either the 12.6kW/m^2 or 4.7kW/m^2 thermal radiation contour radius.

10 tonne excavator impact: No child care centres are within either the 12.6kW/m^2 or 4.7kW/m^2 thermal radiation contour radius.

15 tonne excavator impact: No child care centres are within either the 12.6kW/m^2, one child care centre within 4.7kW/m^2 thermal radiation contour radius.

20, 25, 35 and 55 tonne excavator impact: No child care centres are within either the 12.6kW/m^2, two child care centre within 4.7kW/m^2 thermal radiation contour radius.

Full Bore Rupture: Not credible

By lowering the MOP to 3,500kPag, none of the child care centres are within the 12.6kW/m^2 thermal radiation contour radius, significantly reducing the impact of pipeline failure.

2.5.4 PRESSURE REDUCTION OUTCOMES AND REQUIREMENTS

By reducing the maximum operating pressure of the Canberra Primary Main from 6,200kPag to 3,500kPag, pipeline rupture is no longer a credible failure mode. This complies with AS/NZS 2885's requirement for pipelines located in Sensitive area to be 'No Rupture' [16, 17].

Lowering the MOP will also reduce the impact of pipeline failure on the child care centres adjacent to the Watson to Gungahlin section of the Canberra Primary Main. All three child care centres will be outside of the 12.6kW/m^2 thermal radiation contour radius for pipeline puncture by excavators up to 55 tonnes, with two child care centres within the 4.7kW/m^2 thermal radiation contour radius if an excavator 20 tonnes or greater punctures the pipeline.

Reducing the Canberra Primary Main MOP from 6,200kPag to 3,500kPag will reduce the overall risk rating of pipeline failure impact from INTERMEDIATE to LOW.

As discussed in Section 2.1, gas enters the Canberra Primary Main at two points, one at Fyshwick TRS and the other at Watson CTS. There is pressure control capability at Fyshwick TRS which can be adjusted to ensure Canberra Primary Main MOP does not exceed 3,500kPag. However, there is currently no pressure control at Watson CTS and the gas enters the CPM from the Dalton to Watson Lateral at pressures of between 2,800kPag and 6,200kPag. Therefore, a pressure limiting station is required downstream of Watson CTS to limit the pressure entering the Canberra Primary Main to a maximum of 3,500kPag.

The pressure limiting station is to be designed for 160,000scmh (80% of current winter peak load) to ensure security of supply to the Canberra network in case of Fyshwick TRS failure.

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16 AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction Section 4 Clause 4.9 Provisions for High Consequence Areas

17 AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management Section 5, Clause 5.5.1 Periodical Operational Review

2.6 ASSUMPTIONS

Table 7 lists the assumptions that are applicable to this Options Analysis. The assumptions are to be verified prior to proceeding with the works discussed in this report.

Table 7: General Assumptions and Implications

Assumptions	Implications
There is adequate room in the existing compound to install the Pressure Limiting Station.	If there is insufficient room, then additional land/easement will need to be acquired, resulting in addition time and cost.
There are no issues with the necessary development applications.	Issues with development applications may cause delay to the project.
MOP of 3,500kPag in the Canberra Primary Main is adequate to maintain supply to the Canberra network.	If not, the MOP will need to be increased, thus increasing the impact of pipeline failure on the child care centres. The project may need to be re-evaluated, resulting in additional time and potential additional cost.
Child care centres distances from the CPM in Figure 1 is accurate.	If not, the impact of pipeline failure on the child care centres will need to be reassessed, resulting in additional time.

3. CREDIBLE OPTIONS

The following options were identified :

- Option 1: Maintain status quo
- Option 2: Install a pressure limiting station with two runs – Full redundancy at design maximum load
- Option 3: Install a pressure limiting station with two runs – No redundancy at design maximum load

All options are explained in detail below.

3.1 OPTIONS ANALYSIS

3.1.1 OPTION 1: MAINTAIN STATUS QUO

This option will leave the maximum operating pressure of the Canberra Primary Main at 6,200kPag. This option will incur no capital expenditure (**CAPEX**). The risk of pipeline failure adjacent to the child care centres resulting in catastrophic consequence (multiple fatalities) remains INTERMEDIATE.

The following risks are identified:

- Safety – Pipeline failure cause by excavator 25 tonne or greater may result in multiple fatalities due to child care centres being within the 12.6kW/m^2 thermal radiation contour radius.
- Compliance – The section of the Canberra Primary Main adjacent to the child care centres will not be compliant with AS/NZS 2885 [18, 19] which states that rupture shall not be a credible failure mode for Sensitive location class.

3.1.2 OPTION 2: INSTALL A PRESSURE LIMITING STATION WITH TWO RUNS – FULL REDUNDANCY AT DESIGN MAXIMUM LOAD

This option is to install a pressure limiting station downstream of the APA Watson Custody Transfer Station with two full runs, each run capable of supplying the design maximum load of 160,000scmh at minimum inlet pressure of 2,800kPag.

Each run will consist of the following:

DN300 Run Inlet Pipe >> DN300 Double Block and Bleed >> Filter (to be sized accordingly) >> DN300 Slam Shut Valve >> DN300 Slam Shut Valve >> DN200 Regulator >> DN300 Check Valve >> DN300 Double Block and Bleed >> DN300 Run Outlet Pipe

The regulator will have an outlet set point of 3,500kPag. If the inlet pressure to the pressure limiting station is lower than 3,500kPag, the gas will flow straight through. However, if the inlet pressure to the PLS is greater than 3,500kPag, the regulator will reduce the pressure to 3,500kPag, ensuring the operating pressure of the Canberra Primary Main does not exceed 3,500kPag.

This option addresses the project drivers by:

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[18] AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction Section 4 Clause 4.9 Provisions for High Consequence Areas

[19] AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management Section 5, Clause 5.5.1 Periodical Operational Review

- Safety: Reducing the 12.6kW/m^2 thermal radiation contour radius such that the child care centres are all located outside of the radius.
- Compliance: Reducing the hoop stress to below 30% SMYS to ensure rupture is not a credible failure mode as required by AS/NZS 2885 for pipeline in a Sensitive location.
- Reducing the overall risk rating from INTERMEDIATE to LOW.

3.1.3 OPTION 3: INSTALL A PRESSURE LIMITING STATION WITH TWO RUNS – NO REDUNDANCY AT DESIGN MAXIMUM LOAD

This option is to install a pressure limiting station at downstream of the APA Watson Custody Transfer Station with two runs, each run capable of supplying 80,000scmh at minimum inlet pressure of 2,800kPag. Both runs will need to be operational to supply the design maximum load of 160,000scmh at the minimum inlet pressure. There will be provision for a third run, in case of future load increase or requirement for increased level of redundancy.

Each run will consist of the following:

DN250 Run Inlet Pipe >> DN250 Double Block and Bleed >> Filter (to be sized accordingly) >> DN200 Slam Shut Valve >> DN200 Slam Shut Valve >> DN150 Regulator >> DN200 Check Valve >> DN200 Double Block and Bleed >> DN200 Run Outlet Pipe

The regulator will have an outlet set point of 3,500kPag. If the inlet pressure to the pressure limiting station is lower than 3,500kPag, the gas will flow straight through. However, if the inlet pressure to the PLS is greater than 3,500kPag, the regulator will reduce the pressure to 3,500kPag, ensuring the operating pressure of the Canberra Primary Main does not exceed 3,500kPag.

This option addresses the project drivers by:

- Safety: Reducing the 12.6kW/m^2 thermal radiation contour radius such that the child care centres are all located outside of the radius.
- Compliance: Reducing the hoop stress to below 30% SMYS to ensure rupture is not a credible failure mode as required by AS/NZS 2885 for pipeline in a Sensitive location.
- Reducing the overall risk rating from INTERMEDIATE to LOW.

3.2 COMPARISON OF OPTIONS

Table 8. Options Comparison

Criteria	Option 1	Option 2	Option 3
Option description	Maintain Status Quo	Install a pressure limiting station with two runs – Full redundancy at design maximum load	Install a pressure limiting station with two runs – no redundancy at design maximum load
Safety: Child care centres located outside of 12.6kW/m^2 Thermal Radiation Contour Radius	No	Yes	Yes
Compliance: Pipeline is 'No Rupture'	No	Yes	Yes
Treated Risk Ranking[20]	INTERMEDIATE	LOW	LOW
Cost Estimate[21] (CAPEX, $000's, Real 2020)	0	3,290 for RY2022-24	2,906 for RY2022-24
Net Present Value (NPV[22], $000's, Real 2020)	0	- 3,130	- 2,766
Recommended Order of Preference for Options	**Unacceptable Option**	**2**	**1**

20 Refer to Appendix A Risk Assessment Summary.

21 Coat estimates from Project Estimation Model (PEM)

22 See Appendix B for NPV model extract

4. RECOMMENDATION

4.1 RECOMMENDED SOLUTION

The recommended solution is Option 3: Install a Pressure Limiting Station with Two Runs – No Redundancy at Design Maximum Load. Each run is capable of supplying 80,000scmh at minimum inlet pressure of 2,800kPag.

Both Options 2 and 3 adequately address the project drivers; however, based on historical data from 01 January 2016 to 02 March 2020, the flow through Watson CTS exceeded 80,000scmh for less than 0.5 per cent of the time, with the maximum flow being 143,449scmh[23]. This means that a PLS with 80,000scmh design capacity per run will have 100% redundancy for over 99.5% of the time.

Additionally, with current median flowrate of only around 4,600scmh, the smaller equipment for Option 3 will be more suited for optimal operation than the larger equipment for Option 2.

Therefore, Option 3 is the preferred option.

4.2 COST DETAILS

4.2.1 COST METHODOLOGY

The cost estimate for the recommended option was obtained using the Project Estimation Model (**PEM**).

4.2.2 SUMMARY OF COSTS

Table 9: Project Cost Estimation

Item	Project Estimate ($000's, Real 2020)
Materials	1,456
Contractor Costs	1,224
Jemena Internal Labour	159
Total Direct Costs	**2,839**
Risk Allocation	67
Total Project Estimate	**2,906**

[23] See Appendix C for historical flow chart

5. TERMS AND DEFINITIONS

Term	Definition
ALARP	As Low As Reasonably Practicable
AS/NZS	Australian/New Zealand Standard
CAPEX	Capital Expenditure
CPM	Canberra Primary Main
CTS	Custody Transfer Station
DN	Diameter Nominal
EGP	Eastern Gas Pipeline
HDD	Horizontal Directional Drill
JGN	Jemena Gas Networks
km	kilometre
kPag	kilopascal (gauged)
kW/m^2	Kilowatt per metre square
m	metre
MAOP	Maximum Allowable Operating Pressure
mm	millimetre
MOP	Maximum Operating Pressure
MPa	Megapascal
MPag	Megapascal (gauged)
MSP	Moomba to Sydney Pipeline
NPV	Net Present Value
OD	Outer Diamater
PEM	Project Estimation Model
PLS	Pressure Limiting Station
scmh	standard cubic metre per hour
SMYS	Specific Minimum Yield Strength
TRS	Trunk Receiving Station

6. REFERENCES

6.1 INTERNAL

GAS-4100-RP-IN-007 Review of Pipeline Existing Controls due to Sensitive Development in Throsby Area Rev. 0 http://ecms/otcs/cs.exe/properties/316349171

6.2 EXTERNAL

- National Gas Rules Version 38 15th May 2018 https://www.aemc.gov.au/sites/default/files/2018-04/NGR%20-%20v38.PDF
- AS/NZS 2885.1:2018 Pipelines – Gas and Liquid Petroleum Part 1: Design and Construction
- AS/NZS 2885.6:2018 Pipelines – Gas and Liquid Petroleum Part 6: Pipeline Safety Management

Appendix A Risk Assessment Summary

A risk assessment was conducted to determine the level of risk severity of the untreated risk. The table below shows the summary of results and then the treated risk summary for each option. The risk assessment was undertaken in accordance with AS/NZS 2885.6: 2018 Pipelines-Gas and Liquid Petroleum Part 6: Pipeline Safety Management.

UNTREATED IMPACT/CONSEQUENCES					UNTREATED RISK SUMMARY		
Contributing Factors/ Scenario	People	Supply	Environment	Comments	Consequence (Highest Impact)	Likelihood	Risk Level
Unauthorised external interference using HDD to install utility services under sealed roads leading to hitting the pipeline, resulting in gas escape and ignition.	Severe	Severe	Trivial	• People: Gas ignition above ground may cause injury to people in the surrounding area. • Supply: Short term supply interruption for pipeline repair. • Environment: Minimal impact.	Severe	Remote	Low
Unauthorised external interference using vertical auger or excavators 20 tonne or less, in conjunction with failure of concrete capping, resulting in gas escape and ignition.	Major	Severe	Trivial	• People: Gas ignition may cause serious life-threatening injury or 1-2 fatality to people in the surrounding area. Child care centres located within 4.7kW/m^2 thermal radiation contour radius. • Supply: Short term supply interruption for pipeline repair. • Environment: Minimal impact.	Major	Hypothetical	Low
Unauthorised external interference using excavators 25 tonne or more, in conjunction with failure of concrete capping, resulting in gas escape/pipeline rupture and ignition.	Catastrophic	Major	Trivial	• People: Gas ignition may cause multiple fatalities, primarily due to child care centres located within 12.6kW/m^2 thermal radiation contour radius. • Supply: Potential supply interruption for days for pipeline repair. • Environment: Minimal impact.	Catastrophic	Hypothetical	Intermediate

TREATED RISK SUMMARY

Treated risk	Benefit	Key Mitigations	Consequence	Likelihood	Risk Level
Option 2 - Install a pressure limiting station with two runs – Full redundancy at design maximum load	• All child care centres outside of 12.6kW/m^2 thermal radiation contour radius. • Pipeline is 'No-Rupture'.	• Canberra Primary Main maximum operating pressure reduced to 3,500kPag.	Major	Hypothetical	Low
Option 3 - Install a pressure limiting station with two runs – no redundancy at design maximum load	• All child care centres outside of 12.6kW/m^2 thermal radiation contour radius. • Pipeline is 'No-Rupture'.	• Canberra Primary Main maximum operating pressure reduced to 3,500kPag.	Major	Hypothetical	Low

Appendix B NPV Model

Below is the screenshot of the 'Options Comparison' tab of the NPV model: ***Evoenergy – NPV Model – Watson Pressure Limiting Station.xlsx***

Watson Pressure Limiting Station

Option Comparison

Legend: Input | External link | Internal link | Drop-down

Year	2,021	2,022	2,023	2,024	2,025	2,026
Count	1	2	3	4	5	6

Sheet Navigator

Sheet purpose | Option Comparison - Option Comparison

Summary- NPV Calculation

NPV	Source	Unit	Basis	Timing	NPV	RY21	RY22	RY23	RY24	RY25	RY26
Maintain Status Quo	NPV Calc|Option-1	dollars	Real 2020	n/a	-	-	-	-	-	-	-
Install Watson PLS with Full Redunancy at Design Maximum	NPV Calc|Option-2	dollars	Real 2020	n/a	- 3,130,117	-	- 156,510	- 2,548,515	- 425,092	-	-
Install Watson PLS with No Redundancy at Design Maximum	NPV Calc|Option-3	dollars	Real 2020	n/a	- 2,765,647	-	- 154,393	- 2,257,704	- 353,549	-	-
Selected Option	**Install Watson PLS with No Redundancy at Design Maximum Load, Provision for Third Run**				- 2,765,647						

Incremental NPV for each option in comparison to Option-1 (Maintain Status Quo)

Incremental NPV	Source	Unit	Basis	Timing	Incremental NPV in comparison to base case/maintain status quo option
Maintain Status Quo	Calculated	dollars	Real 2020	n/a	-
Install Watson PLS with Full Redunancy at Design Maximum	Calculated	dollars	Real 2020	n/a	- 3,130,117
Install Watson PLS with No Redundancy at Design Maximum	Calculated	dollars	Real 2020	n/a	- 2,765,647

Appendix C Watson CTS Historical Pressure and Flow

The chart below shows the historical pressure and flow through Watson CTS for the period between 01 January 2020 and 02 March 2020.