Business Case – Capital Expenditure

WCS A Process Safety

Business Case Number BC203 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 this project is to improve the safety and reliability of the Wollert Compressor Station A (WCS A) by implementing upgrades to achieve the following objectives: • Convert unit isolation valves from fail-last to fail-safe configuration • Retrofit check valves to prevent reverse flow and compressor reversal related failures • Conversion from instrument gas to instrument air (hazardous area and Type B improvement) The successful solution will provide a more dependable and safer station that addresses identified process safety vulnerabilities. The project is an ongoing project that had been partially deferred in the current access arrangement period. The project was deferred to address other priorities that emerged during the access arrangement period.
Options Considered	The following options have been considered: Option 1: Do Nothing Option Option 2: Replace compressor packages and associated balance of plant Option 3: Replace and upgrade necessary equipment for process safety concerns. (Preferred option).
Estimated Cost	$1,300,000
Relevant Standards	The proposed upgrade aligns with Australian Standards and ISO 21789.5.20 Control and Automatic Protection Systems and with the As Low As Reasonably Practical principle.
Consistency with the National Gas Rules (NGR)	The replacement of these assets 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)).
Stakeholder Engagement	Stakeholders affected by this project are: • Australian Energy Market Operator • Energy Safe Victoria

Benefits to customers and consumers	The proposal will improve safety of Wollert Compressor Station and reduce the likelihood of disruption to services and improve reliability for shippers, storage facility and end customers. It is the least cost option and proportionate to address the issues. Option 3 is the most prudent and efficient option and offers the greatest benefit to customers and consumers.

3 Background and Project Need

This business case has been raised specifically to address process safety related issues, however Type B compliance (assessments and upgrades) are excluded but are covered in BC271 AA23-27 Type B as part of a larger Type B compliance program.

The original purpose of Wollert Compressor Station A (WCS A) was to compress gas into the T74 pipeline system which supplies gas to most of northern Victoria. The offtake at Wandong also supplies the Bendigo and Ballarat regions helping the workload on Brooklyn compressors.

In 2006 two new compressors were installed at Wollert, known as Station B and became the duty station. Station A was then used as a standby station and received no significant reliability or process safety upgrades.

A station safety instrumented system was installed in 2007 which focused on achieving fail-safe station isolation in the event of fire or gas in the compressor hall. However, the unit process isolation and vent valves are controlled by the relay-based compressor package controls and are fail-last.

More recently, Station A has become more critical after completion of the (T74) looping (also known as Victorian Northern Interconnect Expansion [VNIE]). The reason for this increase in Station A demand is that Station B has been configured to maintain the VNIE at 10,200kPa while Station A now maintains the T74 pipeline between Wollert and Euroa to 7,400 – 8,800 kPa.

The Fail Last positioning of a unit isolation valve is a legacy system and is an out-dated design. This practise was performed by the previous owners, the Gas and Fuel Corporation1, and was considered satisfactory at the time. The current design philosophy is to install Fail Safe positioning of isolation valves associated with turbo machinery which helps prevent consequence escalation. The improvements that are described in sections 3.1 to 3.4 have been recommended to improve the process safety and reliability of Wollert Compressor Station A to reflect its new critical role to maintain T74 pipeline. The recommended improvements include upgrading check valves; isolation valves, instrument air and seal oil and gas starter gas motor.

3.1 Check Valves

Unit check valves: On other compressor stations within the Victorian Transmission System (VTS) there are axial type check valves downstream of the compressor to prevent reverse flow. A check valve failure resulting in reverse flow condition has the potential to severely damage compressor bearings and seals. This has occurred when wafer-style check valves have failed at Brooklyn such as the 2006 incident on BCS 10 and the 1992 incident on BCS 8.

Station check valve: Unlike other typical compressor stations with station recycle valve, the WCS A station does not have a station discharge check valve. The WCS A capacity valve has failed on three separate occasions in the last 10 years resulting in loss of pressure in T74 pipeline, reverse flow is of concern as it can cause substantial damage rotating assets.

The proposal is to replace unit isolation valves with Fail Safe valves. The unit check valve upgrade will prevent reverse flow and subsequent damage. This occurred in WCS A unit 3 in April 2002 and on other compressor units within the VTS.

1 APA acquired GasNet (now known as Victorian Transmission System) in 2006.

3.2 Isolation Valves

The design of the station incorporated valves and actuator on the inlet and outlet pipework to each compressor with "Fail-Last" positioning. This allows for long running machines to maintain their output regardless of a failure of the actuation system. It does however leave the equipment exposed to unsafe operating conditions in the event of actuator failure. There is no protection for the compressor which would be unable to shut itself down should there be a fire in the unit housing that affects other systems.

The valves and actuators have reached the end of their useful life and not recommended for overhaul so the proposal is to replace them with a modern fire rated fail-safe equivalent aligned with ISO 21789.5.20 Control and Automatic Protection Systems.

ISO 21789 5.20 Control and Automatic Protection Systems, Clause 5.20.4 Failure states:

> *"When the control signal is removed from a valve or control device that is essential for shut-down or continued operation with tolerable risk, the valve or device shall automatically move to its fail-safe position. Where indicated by risk assessment, component redundancy or the fail-safe principle for electric circuits shall be used to perform a safety function and provide the necessary SIL [Safety Integrity Level]…" Isolation of gas into the common turbine building is a safety function with SIL rating[2].*

Clause 5.20.8 Gas turbine emergency shut-down system states:

> *"The control system shall be designed so that the emergency shut-down system including the emergency stop buttons, trip not only the gas turbine by acting on the fuel gas shut-off valves to immediately cut off the fuel supply but also all associated equipment upstream and/or downstream if its continued operation can produce a hazard".*

The WCS A is the last compressor station in the VTS to operate units with Fail Last positioning, all others have been upgraded.

3.3 Instrument Air

The use of instrument air is most desirable when upgrading to fail-safe valves. WCS Station B has instrument air available so the intent is that instrument air will be piped to WCS A. The associated benefits of converting to instrument air is the elimination of direct greenhouse gas emissions, a reduction in the hazardous area for gas equipment (particularly in the area of building and machine intakes) and a qualitative increase in safety and availability. It is assumed that station B air compressors can provide adequate instrument air volumes to provide for station A. Instrument gas is undesirable in most circumstances as instrument gas systems vent hazardous, greenhouse gases and require additional safety controls compared to instrument air systems.

3.4 Seal oil and engine starter gas motors

The existing compressor packages utilise gas motors for the engine start system seal oil system. This gas is sourced from the fuel gas system. In the event of gas leakage within the compressor hall, potentially from the power gas system (lubricators and hoses etc.), the gas source cannot be isolated until the package has been stopped and confirmed no pressure in the compressor case. This creates a potential for accumulation of gas and subsequent explosion in the compressor hall.

The most significant benefit is the ability to convert the on-skid motors from power-gas to electric motor. This would allow immediate isolation of all sources of gas into the compressor hall in the event of gas leak detection.

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[2] Safety integrity level rating is used to assess process control systems to define their ability to fail safe, i.e. the response to a failure does not escalate the consequences

4 Risk Assessment

The primary risks associated with reverse spin are the destruction of a compressor resulting in potential injury or fatality to personnel in close proximity to the compressor and disruption to gas supply. Whilst the personnel safety considerations are difficult to quantify the cost of compressor replacement would be at least $4 million and would affect the gas market for approximately 12 months.

TABLE 3: RISK RATING

Risk Area	Risk Level
Health and Safety	Negligible
Environment	Negligible
Operational	Moderate
Customers	Moderate
Reputation	Moderate
Compliance	Moderate
Financial	Low
Final Untreated Risk Rating	**Moderate**

5 Identification and Assessment of Options

5.1 Options Considered

The options considered are:

- Option 1. Do Nothing
- Option 2. Replace compressor packages and associated balance of plant
- Option 3. Replace and upgrade necessary equipment for process safety concerns.

Option 1 – Do Nothing

The Do Nothing option is to persist with a valve arrangement that does not comply with Australian or International Standards for turbomachinery. In addition, the surge protection system has not been upgraded for decades and is significantly inferior to current performance levels. The existing protection for reverse flow has failed at least three occasions in the last 10 years and does not provide equivalent process safety performance as a check valve.

Option 2 – Replace compressor packages and associated balance of plant

This option is to replace all three compressor units including unit isolation and vent valves. The benefit of this option is that all Type B, hazardous area, process safety, reliability, availability issues will be resolved. The cost of this option is estimated to be over $15 million.

Option 3: Replace and upgrade necessary equipment for process safety concerns - Proposed Solution

Option 3 involves replacing and upgrading necessary equipment for process safety concerns including:

- Replace unit isolation valves with Fail Safe valves
- Convert Instrument Gas to Instrument Air
- Install unit check valves
- Electric seal-oil and engine starter motor upgrade

When considering the starter and seal oil pneumatic to electric conversions this work may trigger the need for the control system to be upgraded/supplemented to ensure the electric start and seal oil pump motor can be adequately controlled by the unit to ensure correct ignition sequence and that the wet seal system is adequately sealing the process gas on the compressor.

5.2 Assessment of options

TABLE 4: SUMMARY OF COST/BENEFIT ANALYSIS

Option	Description	Cost	Benefit/Disadvantage
Option 1	Do Nothing	Indeterminate	Low cost/non-compliant, risk of asset damage and supply constraint
Option 2	Replace compressor packages and associated balance of plant	>$15m	Compliant and best solution in terms of remaining life/high cost
Option 3	Replace and upgrade necessary equipment for process safety concerns	$1.3m	Compliant, modest cost/asset remaining life

Option 1 is considered impracticable as it does not address current problems with a valve arrangement, does not comply with Australian or International Standards for turbomachinery and retains out-of-date protection systems. The disadvantage of the Do Nothing option are the risks highlighted leading to a possible process safety event. A process safety event can disrupt reliability of gas supply for shippers and customers and APA personnel. Do nothing is the least preferred option.

Option 2 is the highest cost option and not considered prudent as it is not proportionate to the need that needs to be addressed. The estimated cost of $15 million is based on costs of recent projects at Winchelsea and Brooklyn. For this reason, this option is not considered efficient/prudent expenditure compared to Option 3.

Option 3 provides the most practical and lowest cost solution and is the preferred option.

From 2017 onwards, the station has been operating at a much higher utilisation rate relative to previous years. WCS A has remained a backup station for many years. The new VNIE pipeline has restored WCS A to its original function prior to WCS B. That is, to compress into the DN300 pipeline at 7,400 kPa during peak winter. The restored function of the WCS A has driven the need for the compressor to be upgraded to align with aligned with ISO 21789.5.20 Control and Automatic Protection Systems.

Option 3 is the most prudent and efficient option. It is the least cost option to address the safety and reliability issues of the outdated legacy arrangement on WCS A. Option 3 adopts an incremental and needs based approach to replacement of assets at most risk – rather than replacing the whole compressor units.

Option 3 is the least cost approach to meeting Australian Standards, and improving safety of Wollert Compressor Station. It will reduce the likelihood of disruption to services and improve reliability for shippers, storage facility and end customers. The project will help reduce greenhouse gas emissions from Wollert Compressor Station.

5.2.1 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 preferred option is necessary to meet requirements of the restored and enhanced function of the WCA compressor station.

Efficient

The field work will be carried out by the external contractor that has been used to date, who has demonstrated specific expertise in the installation of the pressure piping facilities in a safe and cost-effective manner. The work will be undertaken consistent with the APA procurement policy. 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

Addressing the risks associated with compressor surge, fail last actuators, compressor reverse flow and replacing assets that have reached the end of their useful life is accepted as good industry practice. In addition, the reduction of risk to as low as reasonably practicable in a manner that balances cost and risk is consistent with Australian Standard AS2885.

To achieve the lowest sustainable cost of delivering pipeline services

The sustainable delivery of services includes reducing risks to as low as reasonably practicable and maintaining reliability of supply. The work will be subject to APA procurement policy to obtain good value.

5.2.2 Forecast Cost Breakdown

TABLE 5: PROJECT COST ESTIMATE,

	Cost
Internal Labour	$300,000
Materials	$600,000
Contracted Labour	$400,000
Other Costs	-
Total	**$1,300,000**

The estimates provided are based on similar upgrades at other compressor stations.

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