Business Case – Capital Expenditure

BCS 8,9 & 10 Decommissioning & 11 Upgrade

Business Case Number BC204 AA23-27

TABLE 1: BUSINESS CASE – PROJECT APPROVALS

Updated By	Adam Newbury Adam Clegg Prasoon Premachandran	Asset Lifecycle Specialist, Asset Management Rotating Engineer, Engineering and Planning Victorian Team Lead Project Delivery, Engineering & Planning
Cost Updated By	Prasoon Premachandran	Victorian Team Lead Project Delivery, Engineering & Planning
Reviewed By	Adam Clegg	Rotating Engineer, Engineering and Planning
Approved By	Kirrily Hawker	Victorian Asset Manager, Asset Management

TABLE 2: BUSINESS CASE – PROJECT OVERVIEW

Description of Issue/Project	Brooklyn Compressor Station utilisation and criticality are predicted to reduce in future years which makes it increasingly difficult to justify ongoing upgrades required to keep the station safe and reliable. A decision needs to be made for each compressor unit to either commit to decommissioning or upgrading to maintain safe and reliable operations. The aim of this project is to improve the reliability and safety of the Brooklyn Compressor Station by addressing the following issues: • Safety and Process Control system are obsolete • Unit 8 & 9 have obsolete (relay logic) unit control systems • Unit 9 & 10 have obsolete (PLC) unit control systems • Unit 8, 9, 10, 11 enclosure fans require upgrade • Unit 8, 9, 10, 11 fuel gas systems are obsolete • Unit 8, 9, 10, 11 exhaust stacks are cracked and corroded The objective of this project is to select the most practical solution(s) to address the above issues whilst ensuring future capacity forecasts can be met.
Options Considered	The following options have been considered: Option 1: Do Nothing Option 2: Total Replacement Option 3: Station upgrade to ensure life past 2031. Option 4: Develop end of life plan to decommission 8,9 & 10, reschedule remaining upgrades in CY28-32. (preferred option)
Estimated Cost of Preferred Option	$750,000 Note: excludes prerequisite scope identified in end-of-life plan and Unit 11 upgrades
Relevant Standards	• Australian Standard AS3814-2018 section 1.2.6: Modification or relocation of an appliance • Energy Gas Safety (Gas Installations) Regulations 2008, Part 5 s35.
Consistency with the National Gas Rules (NGR)	The replacement of these components comply 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	Key stakeholders for this project are: • Australian Energy Market Operator • Energy Safe Victoria • Iona Underground Storage Facility
Benefits to Customers and Consumers	Brooklyn Compressor Station has an important role in providing gas supply in Victoria, however post WORM (Western Outer Ring Main pipeline) AEMO modelling predicts reduced demand for this asset. End-of-life planning for Brooklyn to enable reductions in operating cost while continuing to meet capacity demands is beneficial to customers and stakeholders. Option 4 is considered the most sensible option and it reduces operating costs whilst ensuring safety, reliability of the Brooklyn Compressor Station.

Background

The Brooklyn Compressor Station is in Western Melbourne and provides gas compression from the Dandenong to Brooklyn pipeline into the Brooklyn to Geelong and Brooklyn to Ballarat transmission systems. The current facilities were constructed between 1977 and 2006 and comprise of the following compressor units:

- Two Saturn 10 wet-seal centrifugal compressors (Units 8 & 9)
- One Centaur 40 wet-seal centrifugal compressor (Unit 10)
- Two Centaur 40 dry-seal centrifugal compressors (Units 11 & 12)

Brooklyn compressor station operates throughout the year to provide supply from the metropolitan transmission system into the Brooklyn-Corio and Brooklyn-Ballarat pipelines during the colder months and into the Southwest Pipeline via the Brooklyn-Corio pipeline for injection into the Iona Underground Storage Facility during the warmer months.

The asset management strategy applying to Brooklyn Compressor Station was to seek funding to replace each component of the station as necessary to ensure adequate capacity and reliability of the compressor units and station (refer to issues section below for issues targeted in this business case). Decommissioning has also been considered as an alternative to address the risks but until now it has been difficult to get stakeholder endorsement due to concerns around maintaining adequate contingency.

However, APA received the following feedback from AEMO after submitting the BCS Upgrades business case as part of the VTS AA draft submission (November 2021).

> *The criticality of the Brooklyn CS site will reduce once the WORM project is completed. With the WORM in service, AEMO expects to be less reliant on the Brooklyn CS as the demand in the south-west can be more efficiently supplied from the Outer Ring Main via Wollert. The Brooklyn Centaurs (compressor units 11 and 12) will still be used to support winter demand, especially Ballarat demand, and contribute to the SWP withdrawal capacity on higher demand days. At least two Centaur units will be required to provide this service to ensure redundancy. AEMO envisages that the remaining Brooklyn Centaur (unit 10) may require some upgrades after the WORM is commissioned, however its future operational purpose needs to be considered along with the issues presented by its wet seals (causing oil to enter the DTS). AEMO operation of the Brooklyn Saturns (compressor units 8 and 9) is unlikely to be necessary once the WORM is operational, as the WORM will enable higher pressures to be maintained for Geelong under some supply conditions without compression at Brooklyn CS. AEMO therefore believes APA should be transparent on the remaining life of these compressors, including the forecast timing of their decommissioning.*

APA is treating the AEMO feedback as justification to change to develop an end-of-life plan that looks holistically at Brooklyn compressor station to achieve the following:

1. assess the likely post WORM capacity/redundancy contributions of each compressor unit
2. use point 1. findings to define the anticipated remaining commercial life for each compressor unit
3. use point 2. findings to recommend decommissioning/upgrade/replacement each for each compressor unit
4. identify equipment impacted by point 3. and cost the modifications to mitigate the impacts

5. using outputs from points 1-4. create a strategy, a schedule and a budget for the recommended scope (BCS end-of-life plan)
6. consult with stakeholders and seek endorsement to proceed with the BCS end-of-life plan
7. deliver agreed CY23-27 scope then request remainder for CY28-32

Issues

The issues that need to be resolved through a combination of compressor unit decommissioning and upgrades are out lined in this section.

Several Brooklyn Compressor Station issues are covered separately and as such not considered in detail here, please refer to the following business cases for more detail:

BC242 BCS Unregulated Bypass

BC267 BCS Unit 12 Inlet Filter Upgrade

BC260 Liquids Management

Unit Control Systems

The control systems on units 8 & 9 were installed in 1982 and are 'relay' based. The equipment is old technology and as such the control systems are no longer supported by the equipment manufacturer and spare parts are difficult to source. This creates a risk in the event of a failure. These units will also require new instrumentation to be installed on the skid to permit new control technology.

The control systems on units 10 & 11 were installed in 1999 and utilise a vendor-supplied programmable control system that is now obsolete. This creates a risk in the event of a failure. The upgrade to the latest version of programmable control system from the equipment manufacturer is required.

Station Safety System

The existing safety system is a programmable electronic control system installed circa 1998 and is now outdated and includes safety instrumented functions for units that are no longer in operation. The safety system is due for a major review involving HAZOP, SIL review programming and re-validation to ensure the safety functions meet the current and future safety requirements.

The station safety system does not support Ethernet communications, increasing the difficulty of interfacing with other equipment such as Human Machine Interfaces (HMI) and Remote Terminal Units (RTUs) that are undergoing upgrades. The proposal is to replace the communications module and main processors in the station safety system to improve support, speed up the processing speed and reduce safety times during trip incidents.

Primarily the replacement of safety system is to increase the performance of the system to meet safety requirements. The station safety system controls emergency shutdown processes and other controls to enable safe operation of the entire station.

Station Process Control System

The station process control system was installed circa 1998 at the same time as the station safety system. The station control system provides controls such as pressure control, load sharing, start / stop logic for the compressors, alarms and diagnostic functions. The process control system has logic installed for equipment that is no longer installed at site.

The process control system is due for a major review involving CHAZOP, programming and re-validation to ensure the control system program is up to date and redundant logic is removed.

As with the safety system, the station control system does not support Ethernet communications, increasing the difficulty of interfacing with other equipment such as HMIs and RTUs that are undergoing upgrades. The proposal is to replace the communications module and main processors in the station control system to improve support and improve the processing speed.

Fuel Gas System

The fuel gas system does not comply with the Type B appliance requirements of AS 3814 and needs to be upgraded. The necessary upgrades include:

- Fuel gas vent valve arrangement and relocation outside the compressor building
- Australian Gas Association certified isolation valves
- Logic changes to the start sequence
- Fuel hose upgrade
- Design calculations

The fuel gas upgrade involves installation of a replacement fuel control module by the equipment manufacturer and requires the upgrading of the unit control system as described above.

Ventilation System

The enclosure ventilation system does not meet performance requirements on the hottest days in summer. The unit safety system will shut down the unit when maximum allowable temperature is reached. This has occurred on several occasions in the past. Thus, the capacity of the station and VTS are reduced on hot days.

The enclosure and ventilation fans must be modified or replaced to provide sufficient cooling capacity for continued operation on hot days without reducing VTS capacity.

Exhaust Stack, Units 8, 9, 10 and 11:

The Brooklyn exhaust stacks are in poor condition and require replacement. Turbine exhaust systems are vulnerable to corrosion and fatigue failure due to the high temperatures and turbulent exhaust flows when the turbines are online. The exhaust stacks penetrate the roof of the buildings that house the units and the roofs have asbestos lining that will need to be replaced when exhaust stack replacement occurs.

Figure 1 - Exhaust stack cracking

Inlet Filters, Units 8, 9, 10 and 11

The process air inlet housing and filters have reached end of life and are suffering corrosion with through wall penetrations. The holes created by corrosion bypass the filtration system that is required for turbine integrity.

The air inlet filters for units 10 and 11 are located on the process piping side of the building. Therefore, there is a risk of gas ingestion into operating units in the event of a gas leak in the area resulting in potential total loss of the affected units and adjacent facilities. The proposal is to replace the inlet filters.

Electric Start, Units 8, 9, 10 and 11

The existing starting system installed uses power gas and pneumatic motors. This results in direct gas emissions to the environment on each occasion that a turbine starts or attempts to start. The pneumatic starter systems are no longer supplied on new turbines installed for APA Group, electric starting is the preferred option.

As the compressor packages are located in a common hall with pressurised piping to skid edge, this also presents a leak and explosion threat in the building. Current design demands that this is treated as a station Emergency Shutdown (ESD) to prevent an explosion. Removal of pneumatic piping including fuel gas supply will reduce the potential of station ESD and consequent risks arising from the station vent system.

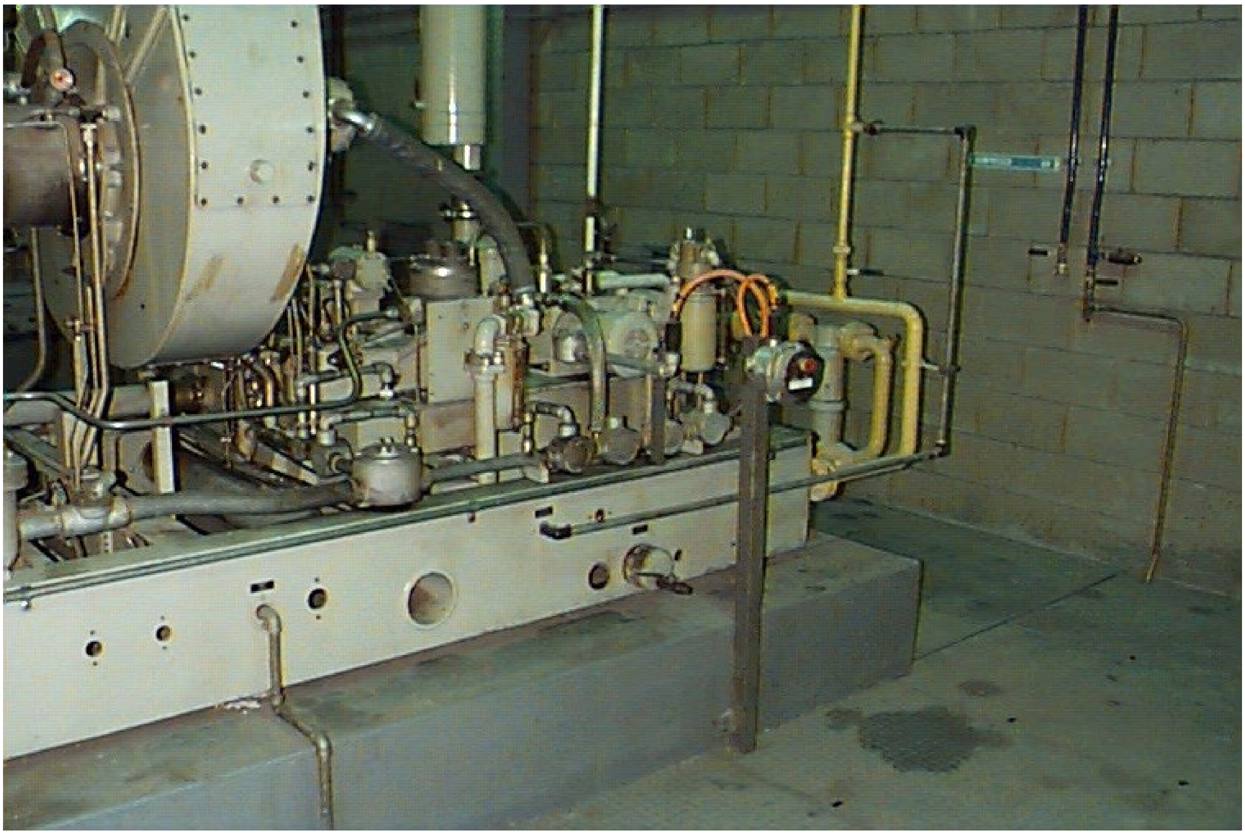

Figure 2 - On-skid pressure piping within building.

The proposal is the convert to electric starting and this requires the upgrade of the unit control system as described above.

Seal gas motors, Units 8, 9, and 10

The existing seal gas system installed on these wet-seal compressor packages uses power gas and pneumatic motors as described above. This also results in direct gas emissions to the environment on each occasion that a turbine starts or stops. Electric drives for the seal-oil system are proposed which will eliminate the gas leakage risk as described above.

Risk Assessment

The following failure modes expected from the current condition of the units:

- Control system failure leading to inability to operate for an extended period

- Failure of exhaust stack and other balance of plant leading to inability to operate for an extended period
- Failure to apply current standards to heavily modified equipment
- Automatic shutdowns that reduce capacity for compression due to insufficient cooling of enclosures
- Direct emissions from power gas system for turbine starts
- Automatic station shutdowns that prevent compression due to gas leaks from the gas start piping and seal-oil systems.

The current risk rating is moderate which is not with APA risk tolerance for Brooklyn Compressor Station.

TABLE 3: RISK RATING

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

Identification and Assessment of Options

1.1 Identification of Options

The following options have been considered:

Option	Description	Costs
Option 1	Do Nothing	Indeterminate
Option 2	Replace four units with three new units	$ 45,000,000
Option 3	Replace balance of plant and control system	$ 15,350,000
Option 4	Develop end of life plan to decommission 8,9 & 10, reschedule remaining upgrades in CY28-32. (Preferred option)	**$750,000**

Option 1 – Do Nothing

The Do-nothing option is to permit the station units to degrade until their failure or until detected and emergency replacement is undertaken.

This option would result in the station being taken out of service on short notice and repairs undertaken in a manner that is not efficient nor consistent with good industry practice. In the event of a failure there will be long delays until plant can be reinstated and this has a significant risk of causing capacity shortfalls in the Victorian Transmission System.

The risk of plant failure at Brooklyn Compressor Station has the potential to interrupt reliability and security of supply for customers and consumers.

Option 2 – Replace all four units with three new compressors

Option 2 involves replacing all four units with three new compressors. The expectation is eventually every component of each unit (8, 9, 10 &11) will be replaced as necessary. Currently the turbine engines are in serviceable condition however the Balance of Plant (BoP) discussed previously will require replacement by 2022 onwards.

This approach will remove the additional costs of design and construction associated with existing plant and will achieve reduced operational cost, risk and capital expenditure profile for at least 15 years.

While the exact cost of this option would depend on more detailed design including considerations of connections into the Brooklyn-Lara Pipeline, alterations to the building, interstage headers and large bore valves are likely to require redesign, creating significant cost changes.

The benefits of this option are:

- The selected replacement compressors would be rated to operate on all Brooklyn Compressor Station connected pipelines. Currently the station configuration prevents optimum availability of compressors.
- The selected replacement compressors would be staged optimally for future flow and pressure requirements leading to more efficient use of these assets.
- The selected replacement compressors will have dry seals, which would stop Unit 8, 9 and 10 oil carryover into the downstream pipelines.

The disadvantages of this option are:

- An overall reduction in power capability, turndown and contingency to permit station maintenance.
- The cost of design and construction in a brown field environment usually costs 15-20% more than similar equipment in a green field environment.
- Uncertainty of demand for Brooklyn Compressor Station post WORM combined with the cost of replacing the compressors (~$45m) make it difficult to justify as feasible.

Option 3 Replace balance of plant and control systems

Option 3 involves the replacement of components on units 8, 9, 10 & 11 including

- control system
- air inlet housing
- exhaust stack
- fuel gas, and
- process safety system and control system software.

The benefits of this option are:

- Aligns with APA's asset management strategy to address obsolescence risks to ensure the Brooklyn Compressor Station compressor units and associated plant are maintained to a level that is compliant, safe and reliable.
- Minimises disruption to customers and allows for effective and efficient scheduling of resources to undertake the work (if compared to recovering from a failure event).
- Is the lowest cost option if continued availability of Units 8, 9 and 10 is necessary.
- Would be the preferred option if option 4 did not get stakeholder endorsement.

The disadvantages of this option are:

- The investment is not supported by AEMO modelling which predicts that Units 8, 9 and potentially 10 will not be required post WORM.
- Units 8, 9 and 10 remain old equipment regardless of the upgrades. This means that inherent issues with assets of that vintage remain even though the controls and supporting systems are upgraded.
- Units 8, 9 and 10 would still run wet seals so oil carryover into the downstream pipelines would remain.

Option 4 Develop end of life plan to decommission 8,9 & 10, reschedule remaining upgrades in CY28-32. (Preferred option)

This option is to develop an end-of-life plan for the Brooklyn Compressor Station consisting of the following steps:

- Develop an end-of-life plan to identify consequences of decommissioning and seek stakeholder approval of the plan in terms of scope of decommissioning and timing.
- Positively isolate the agreed compressor units from the VTS at the agreed timing in the end-of-life plan.
- Isolate all other energy and control systems
- Drain lubrication system and dispose of oil.
- Crane out and transport the compressor packages for disposal/recycling
- Remove all redundant compressor unit and compressor station related control and monitoring equipment.

The anticipated phases of this process for the current access arrangement period are as follows;

Part A. Post-WORM System utilisation study ($150k),

Part B. Assess & scope impacts of study ($150k)

Part C. Execute scopes ($450k)

This option would involve pausing all upgrades at Brooklyn Compressor Station until the post WORM impact on Brooklyn Compressor Station is understood, the need for remaining equipment upgrades would then be assessed and scheduled accordingly.

The benefits of this option are:

- An end-of-life plan allows for a planned execution of decommissioning and allows consideration of consequences. This is superior to spending on assets that according to AEMO modelling are likely to have reduced criticality post WORM.
- Decommissioning assets will reduce operating costs as routine maintenance being conducted currently to keep less critical assets available will no longer be required.
- A reduction in energy consumption, e.g. control systems, climate control, lighting and other utilities.
- Operations field staff will be able to direct their efforts into assets that are contributing to VTS capacity rather than responding to failed test starts on less critical equipment.
- Expensive upgrades required to keep the station operational and compliant will likely not be required. Anticipated that it would cost approximately $10.5m to address all obsolescence, compliance and safety issues. It should be noted that some of these costs may still be incurred where it is established that any units are required post WORM.
- Retiring unused assets also improves overall VTS asset efficiency.

The disadvantages of this option are:

- A minor reduction in contingency, however AEMO modelling indicates that post WORM demand for Brooklyn Compressor Station will reduce dramatically which makes upgrade options difficult to justify.
- The Saturn packages are well sized for low demand periods, Centaurs would not be as efficient in this situation.
- Decommissioning will cost approximately $250,000 per compressor ($750,000). More accurate costings will be established from Part B once we are clear on which units will be decommissioned, as such only minimal decommissioning is included ($450,000).
- Additional scope risk.
  The end-of-life plan will consider demand scenarios to identify capacity or contingency risks resulting from decommissioning. Each of these risks will need to be addressed before proceeding with decommissioning which may require additional funding.

1.2 Assessment of Options

TABLE 4: SUMMARY OF COST/BENEFIT ANALYSIS

Option	Description	Costs
Option 1	Do Nothing	Indeterminate
Option 2	Replace four units with three new units	$ 45,000,000
Option 3	Replace balance of plant and control system	$ 15,350,000
Option 4	Develop end of life plan to decommission 8,9 & 10, reschedule remaining upgrades in CY28-32. (Preferred option)	$750,000

Option 1 Do-nothing is not considered a credible option. Due to their importance for system safety, reliability and security APA cannot continue to operate obsolete compressor units without a plan for upgrades. Do-nothing is not consistent with good industry practice and could also result in APA being liable if an incident could be attributed to the obsolete equipment. Not replacing the proposed components will result in greater risk of asset failures which is to the detriment of APA and stakeholders. In the event of an asset failure, it is likely to result in higher costs compared to a proactive upgrade program. An asset failure usually requires paying a premium for components and resources including labour, increases likelihood of supply shortfall. The do-nothing approach also does not address the risks associated with the obsolescence issues and is therefore not an acceptable option for APA.

Option 2 Replace four units with three new units is not considered a credible option. This the most expensive alternative considered which makes it difficult to justify and unlikely to be supported by stakeholders given the forecasted demand reductions post WORM.

Option 3 Replace balance of plant and control system is considered the most prudent option if option 4 is not approved. This involves continuing the maintenance and upgrade program to align with relevant standards and remains the second preferred option.

Option 4 Develop end of life plan to decommission 8,9 & 10, reschedule remaining upgrades in CY28-32. (Preferred option). This is the most practical option as an end-of-life plan assesses the future need for each compressor unit based on the demand forecasts for Brooklyn Compressor Station. The stakeholder agreed outcomes then become a strategy that defines the timing and actions (upgrade or decommissioning) for the Brooklyn compressor Station assets and also enables APA to incorporate these decisions into our long-term asset lifecycle management plan.

1.2.1 Why are we proposing this solution?

Option 4 enables development and implementation of the long-term asset management strategy of the Brooklyn Compressor by ensuring the safety, reliability, availability of each required compressor unit for the remaining life of the connected assets in a prudent cost effective manner.

Option 4 will address the following concerns by either upgrading or decommissioning each compressor unit and associated plant.

- Unit control systems on several compressor units are obsolete, difficult to maintain and spare parts are no longer supported. Without replacement of control system and instruments, a significant failure of the control system will lead to a prolonged loss of availability. In addition, the latest control systems create a safer platform for process safety control.
- Safety process and control system is software coding that integrates operation of the station. This software customisation is outdated and will not serve functional purpose when the unit control systems are upgraded. This would leave the station control system substantially inferior in performance than required.
- HMI and SCADA equipment requires upgrade of communication hardware in station safety and control systems. The upgrade also requires upgrade of the main processors. This will extend the life of the equipment and improve speed of response of the equipment.

- Anti-surge and fast stop systems prevent upset turbine conditions to reach disastrous consequences. When the unit control system is replaced, the most advanced anti-surge system can be installed.

- Inlet air and exhaust stacks have reached end of life and are in need of replacement. These simple housings are not expected to remain fit for purpose after 2022.

- Type B compliance issues. In accordance with the Gas Safety Regulations (Gas Installations) s.35(b), APA must maintain Type B appliances in a safe condition and in a proper state of repair. The Gas Safety (Gas Installations) Regulations 2008, Part 5 s35 states:

  "A person who is the owner of a complex gas installation must; (b) keep any Type B appliance contained in the complex gas installation in a safe condition and in a proper state of repair"
  In order to achieve compliance with the above stated regulation, the following details each aspect of the proposed replacement project:

  - The fuel gas system physical positioning can create a circumstance where leakage of gas could enter the compressor common building (causing station ESD) or air intake for the turbine (causing upset conditions). The Australian Standards AS3814 for Industrial and Commercial Gas Fired Appliances and AS21789 Turbomachinery have simple diagrams and requirements for fuel gas. The installed turbines do not comply and do not vent fuel gas during an emergency shutdown. Energy Safe Victoria have written to APA (Appendix B) in the past about upgrading gas fired appliances to today's standard and the requirement to implement risk management processes.

  - Similarly, the power gas supply for engine starters and seal gas pumps can create a circumstance where leakage of gas could enter the compressor building, for which station ESD is implemented upon detection of gas. Conversion to electric start reduces routine gas emissions, emergency station venting and the associated risk to public, personnel and property.

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 work is necessary in replace or decommission assets that are not safe, at end of life and obsolete. Planned replacement/decommissioning will allow for effective scheduling of works. Replacement/decommissioning will maintain and improve the safety of services and maintain the integrity of services to customers and personnel. The program aligns with Australian Standard AS3814 and is of a nature that a prudent service provider would incur.
- Efficient – The program will be undertaken consistent with the APA procurement guidelines. The field work will be carried out by external contractors who have demonstrated specific expertise in completing the installation of similar facilities in a safe and cost-effective manner. Planned replacement/decommissioning will allow for efficient scheduling of works. 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 process safety risks and upgrading systems to Australian Standards whenever performing major works, as well as replacing or decommissioning assets/components 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 and Energy Safe Victoria directives (Appendix A).
- 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.

Forecast Cost Breakdown

This cost estimate considers the following scope:

1. End-of-life plan
    a. Conduct an independent capacity study post WORM
    b. Define assets and components being decommissioning
    c. Identify prerequisite actions required before decommissioning can safely occur to ensure the ongoing functionality of remaining plant.
    d. Consult with stakeholders for alignment on scope and timing
2. Isolation/de-energising of assets being decommissioned at earliest agreed timing (i.e. make the assets being decommissioned permanently unavailable)
3. Schedule the final decommissioning and seek funding approval for the removal and disposal/recycling.

TABLE 5: PROJECT COST ESTIMATE

Internal Labour	$100,000
Materials	$150,000
Contracted Labour	$350,000
Other Costs	$150,000
Total	**$750,000**

Note:

Execution of the decommissioning scope is not comprehensively costed in table 5, this will be considered in the end-of-life plan risk identification and assessment processes with the required funding likely to be requested in the CY28-32 period.

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
WORM	Western Outer Ring Main – new pipeline to remove existing VTS capacity constraint.

Appendix

Appendix A – Energy Safe Victoria Correspondence

"ISO 21789 appears to be a very comprehensive standard addressing many aspects of turbine safety not covered by AS 3814. It appears to be non- prescriptive and based on risk assessment procedures. AS 3814 section 5.8 Stationary gas engines and turbines is very similar to ISO 21789 clause 5.10.5.1 under the heading "gas fuel systems."

AS 3814 clause 5.8.1 General in part states" Gas fired turbines that comply with the requirements of ISO 21789 may be deemed by a technical regulator to meet the intent of this standard".

ISO 21789 does not appear to comply with the requirements of AS 3814 clause 2.26.3, Requirements for a programmable electronic system (PES).

I believe that any turbine installed in Victoria which complies with the requirements of ISO 21789 should also comply with the relevant sections of AS 3814, being mindful that much of the valve train, flame proving and flame failure requirements appear to be identical.

Any turbine being installed in Victoria should be submitted in accordance with schedule 9 of the Gas Safety (Gas Installation) Regulations2008.
The requirements set out in AS 3814 clause 2.26.3 should form part of the submission.

AS 3814 and ISO 21789 appear to complement each other however ISO 21789 does not appear to be appropriate as a standalone standard in regard to gas safety".

Subject: RE: AS3814 - Modification to Type B appliances
Date: Monday, 20 February 2012 8:15:55 AM

Dear Alan,

Thank you for your response below.

Any plant change is a critical activity from both safety and operability viewpoints and it is important that as per your Safety Case, risk management process is applied to this particular project to assist with specific decisions or to manage recognised risk areas in order to achieve risk being reduced to ALARP.

You quite correctly point out that "*GSA s44 would seem to permit the field equipment to remain at the existing level of risk, whereas AS3814 ambiguously requires the appliance to be upgraded ...... ISO21789 unambiguously sets out the requirements for the fail-safe design of the complete package*." and as I stated in my email (also below), AS 3814 Clause 5.8.1 states that the requirements of ISO 21789 may be deemed by ESV to meet the intent of AS 3184.

To clarify, while GSA s44 reads that field equipment can remain at the existing level of risk, this does not negate APA's risk management obligation to achieve risk being reduced to ALARP. Consequently, it is not simply an issue of there being a compliance trigger as distinct from a change management risk assessment trigger.

From a Safety Case perspective as well, it is not ESV's intention to deem that the requirements of ISO 21789 meet the intent of AS 3184 or not.

ESV would rather see that APA has considered all of the requirements of both standards as relevant to their proposed scope of work and that they have determined whether the work as proposed will ensure that once completed, risk remains at ALARP.

As mentioned in my earlier email, it is my belief that this is most easily determined by adopting a compliance matrix, identifying gaps and then making sure that these are picked up and addressed in a formal HAZOP. However, as APA has articulated how it deals with risk management in its Safety Case, I only offer this as a suggestion.

I note your timing of 24 Feb and am conscious of the fact that this issue needs to progress quickly. Hopefully, you now have sufficient clarification in order to do so.