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GEA replacement program

December 15, 2023

Business Case

document control

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Table 1.1: Revision Record

Version	Changes Made
0.1	*Initial draft*
0.2	*Feedback received from group discussions*

Table 1.2: Review and Distribution

Name	Role	Action	Sections
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Table 1.3: Approvals

Name	Role	Approval	Date Approved
[redacted]	[redacted]	*Approval*	*07 Dec 2023*
[redacted]	[redacted]	*Approval*	*15 Dec 2023*

Other project specific approvers can be added if required.

Delegation Policy

Contents

1. Executive Summary

1.1. Action Requested

This business case proposes the investment of $18.0 million (CY$2023) to undertake a risk-based Gas Engine Alternators (GEA) replacements over AA5 and AA6 to mitigate a high risk of an unplanned supply interruption. In AA5 $8.0 million (CY$2023) will be incurred of which $4 million (CY$2023) will be allocated to the covered pipeline.[1]

1.2. Options Considered

- Option 1 – Reactive repairs
- Option 2 – Improve diagnostic data and undertake iterative improvements.
- Option 3 – Aged-based GEA replacement program
- Option 4 – Risk-based GEA replacement program (**Recommended option**)

1.3. Project Overview

Several Gas Engine Alternators (GEA's), which generate power at our remote compressor stations, are reaching the end of their useful life. Based on our experience at Yarraloola compressor station, the reliability of our GEA's will reduce over time materially increasing the risk of a supply interruption. Risks are particularly high at our Wiluna compressor station,[2] our most critical compressor station (rated extreme criticality) which is essential to maintaining downstream supply.

We have considered several strategies to manage this risk including reactive replacements, enhanced SCADA monitoring as well as two alternative replacement programs (based on age and risk).

A risk-based planned replacement program emerges as the best balance between cost, risk and performance. In this program, based on a combination of asset condition and asset criticality, we prioritise replacing GEA's at the Wiluna and Wyloo West compressor stations in AA5.

This approach also creates an opportunity to reconfigure our GEAs. This allows for modifying the number, size, or technology (like microturbines) of the engines leading to reduced fuel gas use (costs borne by our customers), emissions (contributing to Australia's emission reduction targets and lowering safeguard mechanism compliance costs) and improved reliability from greater redundancy.

[1] Of the $8 million in costs $4 million relates to Wiluna (100% of costs are allocated to the covered pipeline) and $4 million relates to Wyloo West (100% of costs are allocated to the uncovered pipeline).

[2] Although our new operating philosophy will mean that Wiluna will be used less, it will still be required and remains critical given its location.

2. Background

2.1. Gas Engine Alternators

Gas Engine Alternators (GEA) generate electrical power at the GGP's remote compressor stations. GEA failure can lead to the shutdown of a compressor station and in turn a potential interruption to supply.

Each station is equipped with GEAs to provide a stable power supply, along with supporting systems like controls, instrumentation, and auxiliary equipment. These GEAs, driven by gas-fuelled engines, operate alternator packages and adapt to varying power demands. Each station is installed with either two or three independently controlled GEA's providing a level of redundancy if one fails.

GEAs are supported by integrated cooling systems that manage engine and alternator temperatures, exhaust systems for the safe discharge of combustion gases, and lubrication systems to ensure smooth engine operation. Control systems automatically regulate and monitor the GEAs' performance.

Other associated infrastructure includes the Motor Control Center (MCC) for managing electric motors, busbars for power distribution, and load banks to verify the GEAs' load-handling capacity. Transformers adjust voltage levels as needed, while switchgear and cabling ensure safe and efficient electrical network management. Safety measures include grounding and protection systems to guard against electrical hazards.

2.2. Useful life

GEA's and associated equipment are generally designed with a useful life of between 20 and 30 years. This range is determined by factors such as the wear and tear of mechanical components (from the overall number of hours used and the number of start/stop cycles), environmental conditions, advancements in technology, and the evolution of standards and best practice design and operation. This factors also lead to obsolescence risks where like-for-like spares can no longer be obtained and a withdrawal of manufacturer support.

While engines are regularly overhauled to maintain optimal performance, other supporting components also wear and degrade over time. For example:

- The alternator, exposed to constant mechanical stress and heat, can experience degradation in its windings and bearings.
- The cooling system, critical for temperature regulation, might face efficiency loss due to corrosion or sediment build-up in its components.
- The exhaust system can deteriorate due to prolonged exposure to high temperatures and corrosive exhaust gases.
- The lubrication system may suffer from contamination and breakdown of lubricating fluids, impacting its effectiveness.
- Control panels and electronic components can become outdated due to technological advancements, making them less compatible with modern systems or less efficient in operation.

Additionally, the main assembly frame that houses these components might suffer structural fatigue from continuous vibration and stress. Environmental factors such as extreme temperatures, humidity, and exposure to corrosive environments can further accelerate the wear of these components.

Regular maintenance can mitigate some of these issues, but over time, the cumulative effect of wear and environmental exposure inevitably leads to a decrease in efficiency and reliability.

2.3. GEA Fleet

The GGP's GEA fleet is set out in Table 2.1. Most sites are fitted with [redacted] reciprocating engines. These engines are now obsolete and no longer supported by the manufacturer, although third party spares are available. A shift was made to [redacted] when Turee Creek was designed and constructed.

Table 2.1 GGP GEAs

Station	Name	Type	Brand	Model	Year	Age in 2029
Yarraloola	YLA-GEA1	Gas Engine Alternator	[redacted]	[redacted]	2023	6
	YLA-GEA2	Gas Engine Alternator	[redacted]	[redacted]	2023	6
Wyloo West	WYW-GEA1	Gas Engine Alternator	[redacted]	[redacted]	2009	20
	WYW-GEA2	Gas Engine Alternator	[redacted]	[redacted]	2009	20
Paraburdoo	05-GE-01	Gas Engine Alternator	[redacted]	[redacted]	2003	26
	05-GE-02	Gas Engine Alternator	[redacted]	[redacted]	2003	26
	05-GE-03	Gas Engine Alternator	[redacted]	[redacted]	2006	23
Turee Creek	07-GE-5001	Gas Engine Alternator	[redacted]	[redacted]	2013	16
	07-GE-5201	Gas Engine Alternator	[redacted]	[redacted]	2013	16
Ilgarari	ILG-GEA1	Gas Engine Alternator	[redacted]	[redacted]	1996	33
	ILG-GEA2	Gas Engine Alternator	[redacted]	[redacted]	1996	33
Ned's Creek	NCS-GEA1	Gas Engine Alternator	[redacted]	[redacted]	2009	20
	NCS-GEA2	Gas Engine Alternator	[redacted]	[redacted]	2009	20
Wiluna	WIL-GEA1	Gas Engine Alternator	[redacted]	[redacted]	2001	28
	WIL-GEA2	Gas Engine Alternator	[redacted]	[redacted]	2001	28

Only the GEA's at Yarraloola[3] have been replaced since the pipeline was commissioned. The Yarraloola GEA replacement was driven by the unacceptable high number of trips (roughly one per

[3] Yarraloola is an original compressor station installed when the pipeline was commissioned in 1996. The compressor station is the most critical across the GGP given its role to provide the initial compression along the pipeline.

week) when the GEA's were 23 years old. The trips were caused by a range of issues, as outlined in Table 2.2.

Given the technology available at the time the compressor station was constructed, diagnostic SCADA data was not available hampering our ability to undertake root cause analysis to identify the sources of the reliability issues. While issues could be corrected, station reliability could not be brought up to an acceptable level without an ongoing process of costly, iterative improvements.

Table 2.2 Yarraloola GEA Trip Summary April 2018 – April 2019

Shutdown fault	GEA 1	GEA 2
Water temp high	3	9
Voltage out of range	55	0
Vibration high	3	1
Radiator fan fault	3	0
Reverse power	1	0
Overspeed	8	0
Low frequency	43	2
Failed to synchronise	2	0
Engine oil pressure low	70	56
Engine oil level low	5	3
Emergency stop	15	5
Electrical fault	2	65
Coolant level low	5	3

Given the issues experienced at Yarraloola, we expect to see increasing reliability issues at our other compressor stations. In particular, at Ilgarari (commissioned at the same time as Yarraloola) and Wiluna (5 years older) which are based on the same model and similar design.[4]

2.4. Recent reliability performance

Over the last year, as shown in Table 2.3, a number of reliability events have occurred across all of the GGP's GEAs.

Addressing these reliability events have been hampered by a lack of data collection systems and monitoring installed at these sites. This is largely due to the age of the GEA's and the consequent design which did not include nor provide for data collection systems to be easily retrofitted.

[4] Wiluna is installed with containerised enclosures.

Table 2.3 Reliability data between August 2022 and November 2023

Compressor Station	Site criticality	Failure Investigations	GEA Operational Events (Incident and Near Miss)
Yarraloola	High	3	-
Wyloo West	High	2	-
Paraburdoo	High	10	8
Turee Creek	Moderate	8	9
Ilgarari	High	5	4
Ned's creek	High	9	3
Wiluna	Extreme	2	3

2.5. Revaluation of power requirements

Operational efficiency is driven by the alignment between:

- GEA optimal load: Each GEA has an optimal range and level of load which maximises fuel efficiency, and in turn minimises emissions. Operating outside of this range, whether underloaded or overloaded, leads to increased fuel consumption (and emissions). Oversizing GEAs requires load banks to simulate load. Undersizing GEAs restricts the ability to add additional equipment (such as fugitive emission recovery systems) or meet peak power demands, leading to trips and unreliability.
- Station variable load profile: Compressor stations require high levels of power during turbine compressor start-up but generally lower power requirements once they reach operational efficiency.

Identifying the optimal GEA configuration requires taking into account the size, type and configuration of the GEAs. The obsolete [redacted] operate more efficiently with loads higher than our current station requirements.

Accordingly, there is a potential opportunity to reduce fuel gas consumption and emissions[5] by using smaller reciprocating engines (from an alternative vendor) or potentially micro turbines. In particular, microturbines are particularly effective at dynamically managing fluctuating power demands given their ability to quickly ramp up or down in response to changing load requirements. However, microturbine technology, while newer and is being increasingly deployed, is less established than reciprocating engines creating additional operational complexity and risk.

The benefits of reduce fuel gas usage will flow directly to our customers (as they supply system use gas). The benefits of reducing emissions with support the achievement of Australia's net-zero emissions goal and reduce the number and in turn cost of purchasing Australian Carbon Credit Units (ACCUs) under the safeguard mechanism. At this stage, the forecast cost savings are difficult to

[5] GEA's produce about 3% of the GGP's emissions (~[redacted] tonnes tCO2e per year) incurring a cost of about $0.19 million per year in Australian Carbon Credit Unit (ACCU) purchase requirements under the Safeguard Mechanism Calculated using an ACCU price of $[redacted]/tCO2e.

estimate and are unlikely to justify a GEA replacement alone. However, the benefits could materially increase over the next 5-10 years of the price of ACCU's rises.[6]

Reliability may also be improved through the use of a greater number of smaller engines (whether reciprocating or microturbine) rather than relying on a smaller number of larger engines.

A more detailed technology study is required to identify whether the potential fuel gas and emission reduction benefits outweigh the operational complexity associated with changing vendors and/or introducing new or different technologies.

[6] As expected in some forecasts (see here, here and here for examples).

3. Options assessment

Four options have been considered:

1. Reactive repairs
2. Improve diagnostic data and undertake iterative improvements.
3. Age-based GEA replacement program
4. Risk-based GEA replacement program

3.1. Option 1 – Reactive repairs

The first option considered is an extension of the status quo where we continue to undertake reactive repairs as issues arise. However, by the end of AA5 the operational capability risk will be high[7] as:

- Based on our experience at Yarraloola, we can expect that our older GEA's will begin to fail at higher rates.
- Given the age of our GEA's across our compressor stations we can expect to experience failures across multiple sites – possibly concurrently – increasing the risk of a supply interruption.
- The remote location of the compressor stations and the time it takes to send a technician out to address an issue increasing the consequence of a GEA failure.

Frequent trips in remote locations[8] also increases the risk to our staff and contractors through additional requirements to visit remote site locations.[9]

Given the high and moderate risks, this option was not evaluated further.

Table 3.1 Risk Assessment – Reactive repairs

Risk	Threat	Likelihood	Impact	Residual risk
Operational capability	GEA failure leads to a lack of compression and an unplanned supply interruption	Unlikely	Major	High
Health and safety	Technician's visit to a remote site caused by GEA associated trip outage results in a fatality of life-threatening injuries	Remote	Major	Moderate

[7] This assessment takes into account that two GEA's will need to fail to result in a supply event through a lower likelihood. If there was only a single GEA the likelihood would be higher.
[8] Additional risks driven by restricted communication networks, limited ambulance services (and longer response times), animals and insects (e.g. locust plagues) on the road, risks of bushfire, flood etc, and increased presence of road trains and other heavy vehicles.
[9] Risks are reduced through APA's Fatal Risk Protocol (driving) but can only be eliminated by avoiding site visits.

3.2. Option 2 – Improve diagnostic data and undertake iterative improvements

In this option:

- A limited upgrade is undertaken to implement improved communication interface between the GEA programmable logic controller and station RTU to improve the diagnostic data available over SCADA at a cost of $0.9 million (CY$2023).
- Iterative upgrades and replacement works are undertaken as issues arise and our addressed. It is assumed that one reactive repair will be required per year at a cost of $0.5 million including mobilisation (CY$2023).

These upgrades will enable the deferral of GEA replacements to the end of AA6 but will not avoid the need to eventually replace the units.

The forecast cost of this option is $14.4 million (CY$2023) in present value terms.

Relative to option one, this option reduces the likelihood of the key operational capability risk from high to moderate. There is no change to the health and safety risk due to the continued need for reactive site visits.

Lastly, this option will not allow any benefits from reconfiguration of the GEA's until AA6, reducing the opportunity to reduce costs to customers through lower system use gas costs and reduced requirement to purchase ACCUs.

Table 3.2 Key risks – Improve diagnostic data and undertake iterative improvements

Risk	Threat	Likelihood	Impact	Residual risk
Operational capability	GEA failure leads to a lack of compression and an unplanned supply interruption	Remote	Major	Moderate
Health and safety	Technician's visit to a remote site caused by GEA associated trip outage results in a fatality of life-threatening injuries	Remote	Major	Moderate

3.3. Option 3 – Aged-based GEA replacement program

The third option considered is an aged-based program to replace the GEA's at Ilgarari, Wiluna and Paraburdoo in AA5 and Wyloo West in AA6. This option will cost $13.9 million (CY$2023) in present value terms.

It will also reduce the likelihood of GEA supply interruption and a vehicle related fatality (driven by the need to attend to a GEA associated trip) lowering both risks to low.

This option will also allow the reconfiguration of GEA's potentially allowing the reduction in system use gas costs and emissions. These benefits have not been quantified.

Table 3.3 Key risks – Age based GEA replacement program

Risk	Threat	Likelihood	Impact	Residual risk
Operational capability	GEA failure leads to a lack of compression and an unplanned supply interruption	Rare	Major	Low
Health and safety	Technician's visit to a remote site caused by GEA associated trip outage results in a fatality of life-threatening injuries	Rare	Major	Low

3.4. Option 4 – Risk-based GEA replacement program

The fourth option is to undertake a GEA replacement guided by a combination of asset condition and criticality, taking into account the new compressor operating philosophy.

In this option:

- The Wiluna GEAs are replaced in AA5 – given criticality of the Wiluna compressor station in maintaining downstream compression.
- The Ilgarari GEA replacement is deferred to AA6, given that Ilgarari is shifting to a back-up station role.
- Wyloo West GEAs are replaced in AA5 while the Paraburdoo GEAs are deferred to AA6. Paraburdoo is able to be deferred given it has a higher level or redundancy with three GEA's.

This option is expected to cost $13.1 million (CY$2023) in present value terms and will reduce both key risks to low. While GEA failure rates are likely to be higher than in option 3, the risk to supply in interruption is limited by the criticality of each site. Failures at Ilgarari for instance are much less likely to lead to supply interruptions.

This option will also allow benefits from reconfiguring the GEA's to be realised in AA5.

Table 3.4 Key risks – Risk based GEA replacement program

Risk	Threat	Likelihood	Impact	Residual risk
Operational capability	GEA failure leads to a lack of compression and an unplanned supply interruption	Rare	Major	Low
Health and safety	Technician's visit to a remote site caused by GEA associated trip outage results in a fatality of life-threatening injuries	Rare	Major	Low

3.5. Preferred option

Option 4 undertake a risk-based GEA replacement program is the preferred option as it represents the best balance of cost, risk and performance. It provides the lowest cost outcome that results in an acceptable risk level. It also provides an opportunity to reconfigure the GEA's to bring fuel gas efficiencies and reduced emissions.

Table 3.5 Cost comparison ($millions, $2023)

Option	Present Value	AA5 capex	AA6 capex
Option 1 – Reactive repairs	N/A	N/A	N/A
Option 2 – Improve diagnostic data and undertake iterative improvements	14.4	4.9	17.3
Option 3 – Aged-based GEA replacement program	13.9	14.0	4.0
Option 4 – Risk-based GEA replacement program	13.1	8.0	10.0

Table 3.6 Risk summary

Option	Operational capability	Health and safety
Option 1 – Reactive repairs	High	Moderate
Option 2 – Improve diagnostic data and undertake iterative improvements	Moderate	Moderate
Option 3 – Aged-based GEA replacement program	Low	Low
Option 4 – Risk-based GEA replacement program	Low	Low

3.6. Consistency with the National Gas Rules

The preferred option meets the requirements of Rule 79 and is conforming capital expenditure.[10]

Prudent and good industry practice

Adopting a risk-based approach to asset replacement is accepted good industry practice and achieves the lowest sustainable cost of providing services relative to other approaches.[11]

Replacing end of life GEA's is essentially to maintaining the safety (as components depend on a reliable source of power to function) and integrity of services[12] and is of a nature that a prudent service provider would incur.

Replacing GEA's is also necessary to maintain capacity to meet current levels of demand by avoiding supply interruption caused by a failure of the GEA's, the shutdown of a compressor station and a reduction in compression.[13]

Efficient

APA tenders the provision of GEA replacement works and equipment on a competitive basis. The works will be subject to APA procurement policies. The works will be carried out by external contractors who demonstrate specific expertise in completing the installation of the facilities in a safe

[10] The allocation of costs between the notional covered and uncovered GGP pipelines is addressed separately.
[11] Rule 79(1)(a)
[12] Rule 79(2)(c)(i)&(ii)
[13] Rule 79(2)(c)(iii)&(iv)

and cost-effective manner. The expenditure can therefore be considered consistent with the expenditure that a prudent service provider acting efficiently would incur.

The GEA replacement also creates an opportunity to deliver additional cost reductions to consumer through a reduction in fuel gas usage (as users pay for system use gas) and lower emissions (which in turn reduces opex through a reduced requirement to purchase ACCUs).

To achieve the lowest sustainable cost of delivering pipeline services

Replacing GEA's, compared to other reactive approaches, is the most cost-effective solution to reduce risk from supply interruptions to as low as reasonably practicable.