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GGP

December 15, 2023

Rotating overhaul program

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
[redacted]	[redacted]	*Initiator*	*All*
[redacted]	[redacted]	*Review and Input*	*All*
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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 $26.6 million (CY$2023) to undertake rotating major maintenance of the GGP's rotating plant: turbine compressors, reciprocating compressors and gas engine alternators (GEAs). In AA5 $18.4 million (CY$2023) will be incurred of which $3.1 million (CY$2023) will be allocated to the covered pipeline.[1]

1.2. Options considered.

Turbine compressors

- Option 1 – Program consistent with APA's maintenance regime (**Recommended Option**)
- Option 2 – Reactive approach
- Option 3 – Deploy equipment health monitoring

Reciprocating compressors

- Option 1 – Program consistent with APA's maintenance regime (**Recommended Option**)
- Option 2 – Reactive approach

Gas Engine Alternators

- Option 1 – Program consistent with APA's maintenance regime (**Recommended Option**)
- Option 2 – Reactive approach

1.3. Project overview

The GGP's rotating plant is critical to the safe and reliable supply of gas. This equipment requires regular maintenance to counteract the wear and tear associated with continuous or intermittent operation. Components such as pistons, bearings, blades, seals, and O-rings are all subject to stress and degradation over time, posing risks of equipment failure.

This document evaluates whether to maintain the current approach (of undertaking periodic overhauls consistent with manufacturer recommendations and APA's maintenance regimes) or whether to move to a reactive approach.[2]

We find that reactive approaches are likely to result in an unacceptably high risk to supply interruptions and that the best balance of cost, risk and performance is to maintain the current maintenance regime.

[1] Ccompressor overhauls are allocated based on the unit. Covered compressor units include Yarraloola unit 1, Yarraloola unit 2, Paraburdoo unit 1, Ilgarari unit 1, Ilgarari unit 2 and Wiluna unit 1 – all others are uncovered. GEA's are allocated based on the ratio of covered and uncovered units at each site. The covered ratios are Yarraloola 67%, Paraburdoo 33%, Ilgarari 100%, Wiluna 100%, all others are uncovered (0%).

[2] Servicing is considered operational expenditure (opex) while overhauls capital expenditures (capex).

2. Background

2.1. Rotating equipment

GGP rotating plant consists of:

- Reciprocating and turbine Compressors which compress and move gas through the pipeline. Reciprocating compressors use pistons driven by a crankshaft in a cylinder while turbine compressors employ rotating blades to compress gas, making them better suited for continuous, high-volume compression. Turbines require specialised maintenance due to their high-speed and precision components.
- Gas Engine Alternators (GEAs): supply electrical power at the GGP's remote compressor stations. Powered by gas-fuelled, large piston engines, GEAs drive alternator packages and automatically synchronise to meet varying power demands. Each station has two or three GEAs to ensure a reliable power supply for essential systems like controls, instrumentation, and auxiliary equipment.

Rotating equipment by compressor station is outlined in Table 2.1. Since its original commissioning in 1996, the GGP has undergone several expansions resulting in a mix of rotating plant and equipment. Originally the units were reciprocating compressors. With the addition of more modern turbine compressors the role of the older reciprocating compressors has shifted to a standby-role.

Table 2.1 GGP Rotating Plant

Station	Name	Type	Brand	Model	Year	Role
Yarraloola	YLA-GEA1	Gas Engine Alternator	[redacted]	[redacted]	1996	Duty unit
	YLA-GEA2	Gas Engine Alternator	[redacted]	[redacted]	1996	Duty unit
	YLA-U1	Reciprocating Compressor	[redacted]	[redacted]	1996	Standby
	YLA-U2	Reciprocating Compressor	[redacted]	[redacted]	1996	Standby
	YLA-U3	Turbine Compressor	[redacted]	[redacted]	2003	Duty unit
Wyloo West	WYW-GEA1	Gas Engine Alternator	[redacted]	[redacted]	2009	Duty unit
	WYW-GEA2	Gas Engine Alternator	[redacted]	[redacted]	2009	Duty unit
	WYW-U1	Turbine Compressor	[redacted]	[redacted]	2009	Duty unit
Paraburdoo	05-GE-01	Gas Engine Alternator	[redacted]	[redacted]	2003	Duty unit
	05-GE-02	Gas Engine Alternator	[redacted]	[redacted]	2003	Duty unit
	05-GE-03	Gas Engine Alternator	[redacted]	[redacted]	2006	Duty unit
	PBD-U1	Turbine Compressor	[redacted]	[redacted]	2003	Not in service.
	05-TC-01-2	Turbine Compressor	[redacted]	[redacted]	2006	Duty unit
	05-TC-01-3	Turbine Compressor	[redacted]	[redacted]	2013	Duty unit

Turee Creek	07-GE-5001	Gas Engine Alternator	[redacted]	[redacted]	2013	Duty unit
	07-GE-5201	Gas Engine Alternator	[redacted]	[redacted]	2013	Duty unit
	07-TC-2201	Turbine Compressor	[redacted]	[redacted]	2013	Duty unit
	07-TC-3201	Turbine Compressor	[redacted]	[redacted]	2013	Duty unit
Ilgarari	ILG-GEA1	Gas Engine Alternator	[redacted]	[redacted]	1996	Duty unit
	ILG-GEA2	Gas Engine Alternator	[redacted]	[redacted]	1996	Duty unit
	ILG-U1	Reciprocating Compressor	[redacted]	[redacted]	1996	Standby
	ILG-U2	Reciprocating Compressor	[redacted]	[redacted]	1996	Standby
Neds Creek	NCS-GEA1	Gas Engine Alternator	[redacted]	[redacted]	2009	Duty unit
	NCS-GEA2	Gas Engine Alternator	[redacted]	[redacted]	2009	Duty unit
	NCS-U1	Turbine Compressor	[redacted]	[redacted]	2009	Duty unit
Wiluna	WIL-GEA1	Gas Engine Alternator	[redacted]	[redacted]	2001	Duty unit
	WIL-GEA2	Gas Engine Alternator	[redacted]	[redacted]	2001	Duty unit
	WIL-U1	Turbine Compressor	[redacted]	[redacted]	2001	Duty unit

2.2. Operating context

In developing the GGP's overhaul program, several factors have been considered including:

- APA's maintenance regimes. These regimes are applied across all high-pressure pipelines managed by APA and are not specific to the GGP. They consider a range of factors such as historical performance, reliability, risks, and overhaul costs, which vary depending on the overhaul timeframes and asset condition.
- Expected utilisation and run order. As described in the Asset Performance and Lifecycle Plan, the operating philosophy and run order for the GGP has been optimised to reduce emissions, reduce fuel gas consumption for GGP customers and take advantage of the connection of the Northern Goldfields Interconnect (NGI). Key implications include:
    - All compressor stations will continue be required to meet contractual obligations and capacity to move gas from Yarraloola throughout the pipeline. The exception is Paraburdoo unit 1 which is not required to meet demand.
    - All turbine compressors are expected be required on most days. However, with the NGI there will be a reduced need for compression towards the southern end of the pipeline at Ned's Creek and Wiluna.

- The GGP context – including the GGP's remote location, limited spare compression capacity and high consumer value on reliability. These factors support the adoption of a proactive maintenance strategy to manage reliability risks.
- Good industry practice – is to undertake preventative maintenance of compressors given the benefits of reduced failures, more easily forecast costs, and management of spare parts which often have long lead times. Reactive approaches to rotating equipment on remote transmission pipelines is generally avoided due to associated operational issues, additional costs, and risk to deliver on contractual obligations.[3]

[3] E.g. the Dampier to Bunbury Pipeline also adopts a proactive approach (see here)

3. Turbine compressors

3.1. Background

Gas turbine engines operate at high temperatures and speed with very close machine tolerances. Internal components moving at high speeds are subject to wear due to the large air volumes and thermal fatigue from high internal operating temperatures. As a result, without appropriate maintenance and monitoring, internal components will degrade and ultimately lead to a failure and catastrophic damage to the turbine.

The probability and consequence of failure increases over time due to the wear on individual components.

All turbines on the GGP are manufacturer by [redacted] APA [redacted] who overhauls the engine. An overhaul returns the engine, power turbine and auxiliary gearbox to zero-hour (equivalent to new) condition. The turbine blades, wear parts (discs, seals and shafts) are reworked or replaced as required. To reduce downtime, the turbines are exchanged (rather than sent for overhaul and returned).

Engine exchanges are subject to conditions. The turbine must be in running condition or the overhaul incurs a cost multiplier [redacted] The cost of the overhaul increases for every hour over 30,000. If these conditions are not met an exchange will be refused (requiring a new engine to be purchased) or additional costs will be charged.

Under APA's maintenance regime overhauls are scheduled to occur around at 32,000 hours (subject to condition assessment) to align with servicing intervals (4,000 hours). This is slightly above [redacted] recommended timeframe of 30,000 hours. This approach has been adopted on the basis that the direct cost savings and operational efficiency benefits of aligning servicing and overhauls outweigh the additional reliability risks of a failure between 30,000 and 32,000 run hours.

Recent advancements in monitoring technology and data analytics have the potential to extend overhaul timeframes. This would require installing additional monitoring equipment to allow the manufacturer to remotely assess equipment health. Overhaul extension would only be possible if the condition of the engine was satisfactory. At this stage, no assessment on the feasibility or commercial viability of this technology has been completed.

In additional to run-hours, engine starts causes high thermal stress on the turbine and risk damage to internal components. Engine starts have not been a major driver of maintenance, given the historically high levels of compression needed across the pipeline (and the high run-hours per compressor). However, with lower expected utilisation of the Neds Creek and Wiluna compressor stations this may be a greater factor in the future. This risk will be monitored as part of the inspection regime.

Lastly, supply chain constraints are another key factor to consider. While the supply of turbine components has return to pre-COVID levels, given the high value of the components (and the reluctance of suppliers to hold a large number of spares) there is still a three-month lead time for a new engine. As a result, if a catastrophic failure occurs there is a significant risk of limited compressor availability for this duration (in addition to the cost of purchasing a new engine rather than undertaking an engine exchange).

3.2. AA4

Over the 2020-2024 AA period, turbine overhauls were undertaken consistent with APA's maintenance regimes, as outlined in Table 3.1.

Table 3.1 AA4 Turbine overhauls

Turbine Compressor	Last overhaul date	Hours at overhaul
Turee Creek	March 2023	33,900
Wiluna	October 2022	32,700
Neds Creek	October 2020	32,800
Yarraloola	September 2020	36,000
Wyloo West	October 2019	33,000

3.3. Options assessment

Four options have been considered:

- Option 1 – Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan.
- Option 2 – Move to a reactive replacement approach.
- Option 3 – Deploy advanced monitoring equipment and defer overhauls by 4,000 hours.

Option 1 – Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan.

In this option APA's maintenance regime is continues to apply to the GGP. Turbine compressor overhauls continue to occur at 32,000 hours. Over the period to 2029 period, this will require 9 overhauls in 2024 and AA5, as outlined in Table 3.2. The basis for this forecast is set out in Appendix 1.

The total cost of these overhauls is $17.6 million ($CY2023) in present value terms.

Table 3.2 Forecast Turbine Compressor Overhauls

Station	Unit	Overhaul forecast
Yarraloola	YLA-U3	CY24, CY28
Wyloo West	WYW-U1	CY27
Paraburdoo	05-TC-01-3	CY25, CY28
Turee Creek	07-TC-3201	CY24
Neds Creek	NCS-U1	CY24, CY28
Wiluna	WIL-U1	CY27

Table 3.3 Risk of program based on APA's maintenance regime

Risk	Threat	Likelihood	Consequence	Risk
Operational capacity	Catastrophic failure of a turbine compressor leading to a loss of capacity to maintain supply	Remote	Major	Moderate

Option 2 – Move to a reactive replacement approach.

A run to failure approach is sometimes applied for rotating equipment. This approach is typically applied in processing facilities built with additional redundancy and where engines can be easily accessed and inspected. Reliability risks are effectively managed through the asset design rather than through maintenance regimes.

In contrast the GGP was not designed to operate with redundant compressors (Wyloo West, Neds Creek and Wiluna all operate single compressor units), is remote (making regular inspections difficult and delaying repairs) and is fully contracted with no spare capacity. As a result, running turbine compressors to failure will result in unplanned supply disruptions that, due to lead times on parts, could last for months.

Unplanned supply interruptions would result in immediate safety consequences and require the shutdown of their operations (with substantial financial impacts for our customers and the broader economy) until supply could be restored.

Table 3.4 Risk assessment of moving to a reactive replacement approach

Risk	Threat	Likelihood	Consequence	Risk
Operational capacity	Catastrophic failure of a turbine compressor leading to a loss of capacity to maintain supply	Frequent	Major	Extreme

Option 3 – Deploy equipment health monitoring

In this option we opt to deploy equipment health monitoring technology to extend overhaul timeframes. As no feasibility study or commercial viability of this technology has been completed, we cannot forecast the cost or benefits with any confidence.

However, we consider it would be reasonable to assume that deploying compressor monitoring technology with a [redacted] could:

- cost in the order of [redacted]
- allow the turbine overhauls to be delayed by between one and two services (4,000 – 8,000 hours). As the average compressor annual run hours is in the order of 6,000 hours we have assumed that overhauls could each be delayed by about 1 year on average (relative to option 1).

Remote monitoring of the turbines may also lead to improvements in turbine operations and reductions in fuel gas usage and emissions. The value of these reductions could be material given that most of the GGP's emissions are due to fuel gas consumption for compression – in the order of 100,000 tCO2e per year. We have not quantified these benefits from reduced system use gas, emissions or the benefits of reducing servicing costs.

There is no change to the risk in this option relative to option 1.

The cost of this option is $28.8 million ($CY2023) in present value terms.

Table 3.5 Risk of program based on advanced monitoring equipment

Risk	Threat	Likelihood	Consequence	Risk
Operational capacity	Catastrophic failure of a turbine compressor leading to a loss of capacity to maintain supply	Remote	Major	Moderate

3.4. Preferred option

The preferred option is to undertake turbine compressor overhauls based on APA's maintenance regime.

The reactive run to failure approach has been discounted based on the extreme reliability risks while the advanced health monitoring option has been discounted due to the higher cost.

Table 3.6 Option comparison ($millions)

Option and Description	Capex ($CY2023)	Present Value of costs[4]	Risk
1. Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan	20.5	17.6	Moderate
2. Move to a reactive approach	Unknown	Unknown	Extreme
3. Deploy advanced monitoring equipment	[redacted]	[redacted]	Moderate

[4] 4.25% WACC, discounted back to 2024.

4. Gas Engine Alternators

4.1. Background

Gas engines alternators (GEAs) convert mechanical energy from a gas-powered engine into electrical energy by creating an alternating current. This alternating current is then converted into a direct current through a rectifier and, in the case of the GGP, is used to power various electrical components and auxiliar equipment within each compressor station.

Like any mechanical system, GEAs experience wear over time but with proper maintenance, regular servicing and adherence to manufacturer's guidelines, their life can be significantly extended. Without regular maintenance and overhaul, these engines would experience issues such as decreased lubrication effectiveness, increased friction leading to part degradation, accumulation of debris and breakdown.

Except for the GEA units at Turee Creek and those currently being installed at Yarraloola, all GEAs on the GGP are [redacted]

In line with original equipment manufacturer recommendations, both [redacted] require:

- <u>Top End overhauls at 15,000 and 45,000 hours</u> – which typically involves refurbishing or replacing components located in the upper part of the engine. This process focuses on the cylinder head, valves, valve guides, seals, gaskets, and related components. The upper part of the engine is disassembled to gain access to the internal components, inspected for wear damage or signs of malfunction, cleaned, then reassembled with refurbished or new components where necessary. The engine then undergoes testing to ensure proper function before being returned to service.

- <u>An in-frame overhaul at 30,000 hours</u> – more extensive than a top-end overhaul and involves the refurbishment or replacement of major components within the engine while it remains installed in the chassis or frame of the equipment. Generally, all ancillary and peripheral systems are disconnected before partial disassembly of the engine including cylinder head, pistons, liners, connecting rods and other components. All parts are inspected with necessary parts replaced or refurbished. Cleaning takes place before reassembly and testing. Following testing, adjustments are often required to fine-tune performance before all peripheral equipment is reconnected.

At 60,000 hours the engines are exchanged.

These maintenance intervals have been adopted on the basis that the operational efficiency benefits of aligning servicing and overhauls outweigh the additional reliability risks of complete engine failure.

As with turbine engines, supply chain constraints are another key factor to consider. While the supply of turbine components has returned to pre-COVID levels, there can still be a significant lead time for replacement parts. As a result, if a catastrophic failure occurs there is a significant risk of limited compressor availability.

4.2. AA4

Over the 2020-2024 AA period to date, GEA overhauls were undertaken consistent with APA's maintenance regimes as outlined in Table 4.1.

Table 4.1 AA4 GEA overhauls

GEA	Overhaul year	Overhaul type
Wyloo West GEA 2	Out of Frame Overhaul	2023
Neds Creek GEA 1	Out of Frame Overhaul	2022
Paraburdoo GEA 3	Out of Frame Overhaul	2022
Wiluna GEA 2	In Frame Overhaul	2021
Yarraloola GEA 1	Top End Overhaul	2021
Turee Creek GEA 2	In Frame Overhaul	2021
Ilgarari GEA 2	Top End Overhaul	2020
Wyloo West GEA 1	Top End Overhaul	2020
Wyloo West GEA 2	Top End Overhaul	2020
Neds Creek GEA 2	In Frame Overhaul	2020
Yarraloola GEA 2	Top End Overhaul	2020

4.3. Options assessment

Two options have been considered:

- Option 1 – Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan.
- Option 2 – Move to a reactive replacement approach.

Option 1 – Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan.

In this option APA's maintenance regime is continues to apply to the GGP. GEA overhauls continue at 15,000-hour and 30,000-hour intervals and engine are exchanged at 60,000 run hours.

Based on the run-hour forecast (Appendix 1), over the period to 2029, 35 overhauls will be required as outlined in Table 3.2.

The cost of these overhauls is $5.1million ($CY2023) in present value terms.

Table 6.4.2 Forecast Top End and In Frame Overhauls

Station	Unit	Overhaul forecast	Overhaul Due
Wyloo West	Unit 1	CY25/26 CY 26/27	Top end GEA Replacement

		CY 28/29	In frame
	Unit 2	CY24/25 CY26 to CY28 CY28/29	Top end GEA Replacement Top end
Paraburdoo	Unit 1	CY24/25 CY27/28	Top end In frame
	Unit 2	CY25/26 CY26/27	In frame Top end
	Unit 3	CY24/25 CY25/26 CY27/28	Top end In frame Top end
Ilgarari	Unit 1	CY24/25 CY26/27 CY27/28	Exchange Top end In frame
	Unit 2	CY24/25 CY28/29	In frame Top end
Turee Creek	Unit 1	CY26/27 CY29/30	Top end Exchange
	Unit 2	CY25/26 CY27/28 CY28/29	In frame Top end Exchange
Neds Creek	Unit 1	CY25/26 CY27/28	In frame Top end
	Unit 2	CY26/27	In frame
Wiluna	Unit 1	CY24/25 CY26/27 CY27/28	Top end GEA Replacement Top end
	Unit 2	CY24/25 CY27/28	Top end GEA Replacement
Yarraloola	Unit 1	CY25/26 CY27/28 CY28/29	Top end In frame Top end
	Unit 2	CY26/27	Top end

Table 6.2 Risk of program based on APA's maintenance regime

Risk	Threat	Likelihood	Consequence	Risk
Operational capacity	GEA failure leading to a loss of capacity to maintain supply	Rare	Major	Low

Option 2 – Move to a reactive replacement approach.

As outlined above in the case of turbine compressors, a run to failure approach is sometimes applied for rotating equipment in processing facilities. While there is a degree of redundancy (as a compressor station can be operated with a single GEA in service), there is still a risk that a GEA failure will result in an unplanned supply disruption.

The cost of this option is unknown. It would ultimately depend on the frequency of failures, whether additional inspections could identify imminent failure and the extent of supplier cost increases (which would likely depend on the type of failure and extent of damage).

Table 6.3 Risk assessment of moving to a reactive replacement approach

Risk	Threat	Likelihood	Consequence	Risk
Operational capacity	Catastrophic failure of a turbine compressor leading to a loss of capacity to maintain supply	Occasional[5]	Major	High

4.4. Preferred option

The preferred option is to undertake GEA overhauls based on APA's maintenance regime.

The reactive run to failure approach has been discounted on the basis of the high reliability risks.

Table 4.3 Option comparison ($millions)

Option and Description	Capex ($CY2023)	Present Value of costs[6]	Risk
1. Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan	6.1	5.1	Low
2. Move to a reactive approach	Unknown	Unknown	High

[5] Likelihood is lower than the equivalent risk for turbine compressors as GEA's have a degree of redundancy. Consequence of a loss of supply is equivalent.

[6] 4.25% WACC, discounted back to 2024.

5. Reciprocating Compressors

5.1. Background

There are four reciprocating compressor engines on the GGP, two units at Yarraloola and two units at Ilgarari. These four units are [redacted] and were commissioned in 1996.

Under APA's maintenance regime, overhauls are scheduled to occur at 16,000 hours (subject to condition assessment), 24,000 hours, 32,000 hours, and 48,000 hours. This approach has been adopted on the basis that the operational efficiency benefits of aligning servicing and overhauls outweigh the additional reliability risks of complete engine failure.

5.2. AA4

Over the 2020-2024 AA period, reciprocating overhauls were undertaken consistent with APA's maintenance regimes. Specifically:

- Yarraloola unit 1 in CY21.
- Yarraloola unit 1 in CY23.

5.3. Options assessment

Two options have been considered:

- Option 1 – Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan.
- Option 2 – Move to a reactive replacement approach.

Option 1 – Program based on APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan.

In this option APA's maintenance regime is continues to apply to the GGP. As all four reciprocating compressor engines are expected to be stand-by units, rather than duty units, they are expected to have comparatively low operating hours compared with other units on the pipeline.

As a result, we do not expect to perform any overhauls on the reciprocating units over AA5 and we are not forecasting any costs to be incurred.

Table 5.1 Risk of program based on APA's maintenance regime

Risk	Threat	Likelihood	Consequence	Risk
Operational capacity	Catastrophic failure of a reciprocating compressor leading to a loss of capacity to maintain supply	Rare	Major	Low

Option 2 – Move to a reactive replacement approach.

Consistent with our approach for turbine compressors we have also considered shifting to a reactive approach for our reciprocating compressors.

While the risk is lower (due to a lower likelihood of an event given that these units are used less frequently) the risk remains high.

The cost of this option is unknown. It would ultimately depend on the frequency of failures, whether additional inspections could identify imminent failure and the extent of supplier cost increases (which would likely depend on the type of failure and extent of damage).

Table 5.2 Risk assessment of moving to a reactive replacement approach

Risk	Threat	Likelihood	Consequence	Risk
Operational capacity	Catastrophic failure of a reciprocating compressor leading to a loss of capacity to maintain supply	Unlikely[7]	Major	High

5.4. Preferred option

The preferred option is to continue to apply APA's maintenance regime consistent with the Asset Performance and Lifecycle Plan. There is no forecast spend for these units in AA5.

[7] Likelihood is lower than the equivalent risk for turbine compressors given that the turbine compressors are used more often. Consequence of a loss of supply is equivalent.

6. Consistency with the National Gas Rules

Undertaking rotating equipment major maintenance in accordance with APA's maintenance regimes and the Asset Performance and Lifecycle Plan meets the requirements of Rule 79 and is conforming capital expenditure.[8]

Prudent and good industry practice

Undertaking preventative maintenance of rotating equipment is accepted good industry practice and achieves the lowest sustainable cost of providing services relative to other approaches.[9] Preventative maintenance reduces failures, allows more easily forecast costs, and management of spare parts which often have long lead times. Reactive approaches to rotating equipment on remote transmission pipelines is generally avoided due to associated operational issues, additional costs, and risk to delivery of contractual obligations.[10]

Preventative maintenance is necessary to reduce the risks to reliability and security of supply and in turn required to maintain capacity to meet levels of demand which current exist as well as to maintain the integrity and safety of services.[11]

Efficient

Undertaking rotating equipment major maintenance is the most cost-effective option (relative to other options such as running to failure or deploying health monitoring) and is based on a run hour forecast which takes into the account new optimised operating philosophy (allowing the deferral of works).

Preventative maintenance is planned, scoped, and managed by APA's rotating engineers who leverage their knowledge and expertise from managing rotating equipment across a large number of pipelines across Australia (both owned and operated by APA). Delivery of works is undertaken by a combination of APA technical staff together with specialist external providers. These specialist external providers demonstrate specific expertise and are engaged on a competitive basis subject to APA's procurement policies.

Accordingly, preventative maintenance expenditure is what a service provider acting efficiency would

To achieve the lowest sustainable cost of delivering pipeline services

Undertaking rotating equipment preventive maintenance is the most cost-effective option and achieves the lowest sustainable cost of providing services. Expenditure of this nature has been approved by the regulators for other pipeline assets.

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8 The allocation of costs between the notional covered and uncovered GGP pipelines is addressed separately.
9 Rule 79(1)(a)
10 The Dampier to Bunbury Pipeline adopts a proactive approach (see here)
11 Rule 79(2)(c)(i), (ii) and (iv)

Appendix 1. Run hour projections.

Table 6.1 Turbine Compressor Run Hour and Overhaul Forecast

Station	Unit	Hours#	Usage	Run order adjustment	CY23	CY24	CY25	CY26	CY27	CY28	CY29	CY30
Yarraloola	YLA-U3	25,671	8,810	0	27,874	4,684	13,494	22,304	31,114	7,924	1,6734	25,544
Wyloo West	WYW-U1	33,226	8,569	0	3,368	11,937	20,506	29,075	5,644	14,213	22,782	31,351
Paraburdoo	PBD-U1	-	-	0								
	05-TC-01-2	2,046	220	0	2,101	2,321	2,541	2,761	2,981	3,201	3,421	3,641
	05-TC-01-3	25,165	8,470	0	27,283	3,753	12,223	20,693	29,163	5,633	14,103	22,573
Turee Creek	07-TC-2201	2,151	4,380	0	3,246	7,626	12,006	16,386	20,766	25,146	29,526	1,906
	07-TC-3201	28,003	4,380	0	29,098	1,478	5,858	10,238	14,618	18,998	23,378	27,758
Neds Creek	NCS-U1	25,043	8,397	-20%	26,722	1,440	8,158	14,875	21,593	28,310	3,028	9,746
Wiluna	WIL-U1	6,524	8,500	-20%	8,224	15,024	21,824	28,624	3,424	10,224	17,024	23,824

Table 6.2 GEA Run hour and overhaul forecast

Location	Driver	Driven	Run Hours	Hrs per Year	Last Overhaul		End FY24	End FY25	End FY26	End FY27	End FY28	End FY29	End FY30
			Hrs At Aug '23		Type	Hours							
Yarraloola	GEA 1	[redacted]	53,286	8,760	TE	45,000	62,046	70,806	79,566	88,326	97,086	105,846	114,606
Yarraloola	GEA 2	[redacted]	58,952	4,380	TE	45,000	63,332	67,712	72,092	76,472	80,852	85,232	89,612
Wyloo	GEA 1	[redacted]	6,685	4,380	MAJ	60,000	11,065	15,445	19,825	24,205	28,585	32,965	37,345
Wyloo	GEA 2	[redacted]	59,706	8,760	TE	45,000	68,466	77,226	85,986	94,746	103,506	112,266	121,026
Paraburdoo	GE-01	[redacted]	60,063	4,380	MAJ	49,209	64,443	68,823	73,203	77,583	81,963	86,343	90,723
Paraburdoo	GE-02	[redacted]	61,592	4,380			65,972	70,352	74,732	79,112	83,492	87,872	92,252
Paraburdoo	GE-03	[redacted]	53,345	8,760	MAJ	45,435	62,105	70,865	79,625	88,385	97,145	105,905	114,665
Turee Creek	GE-5001	[redacted]	31,421	4,380	TE	17,500	35,801	40,181	44,561	48,941	53,321	57,701	62,081
Turee Creek	GE-5201	[redacted]	47,788	8,760	MAJ	41,018	56,548	65,308	74,068	82,828	91,588	100,348	109,108
Ilgarari	GEA 1	[redacted]	124,774	8,760	IF	105,473	133,534	142,294	151,054	159,814	168,574	177,334	186,094
Ilgarari	GEA 2	[redacted]	108,746	4,380	TE	102,843	113,126	117,506	121,886	126,266	130,646	135,026	139,406
Neds Creek	GEA 1	[redacted]	56,260	8,760	MAJ	48,000	65,020	73,780	82,540	91,300	100,060	108,820	117,580
Neds Creek	GEA 2	[redacted]	67,327	4,380	MAJ	50,000	71,707	76,087	80,467	84,847	89,227	93,607	97,987
Wiluna	GEA 1	[redacted]	96,257	8,760	TE	70,779	105,017	113,777	122,537	131,297	140,057	148,817	157,577
Wiluna	GEA 2	[redacted]	98,956	4,380	MAJ	89,000	103,336	107,716	112,096	116,476	120,856	125,236	129,616

(red)	Exchange	(green)	Top End	(yellow)	In Frame