Business Case – Capital Expenditure

Turbine Overhaul

Business Case Number 235

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	Turbine Overhaul of: • The T4002 gas turbine engine in Gooding Unit 3 is expected to reach overhaul runtime during the period 2018-2022. • The T6102 gas turbine engine in Wollert Unit 4 and Unit 5 are expected to reach overhaul runtime during the period 2018-2022. • The overhaul of the engine is a relatively simple process and will permit another 32,000 hours of engine life
Options Considered	The following options have been considered: 1. Option 1: Do Nothing Option 2. Option 2: Complete Overhaul at Recommended Life 3. Option 3: Overhaul Based on Inspection
Estimated Cost	$4,598,991
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	The turbine engine provides power and thus capacity to the VTS. The stakeholders effected are: • Australian Energy Market Operator • Original Equipment Manufacturer

3 Background

APA utilizes Solar gas turbine engines in compressor packages located at numerous sites on the VTS. These are: Gooding CS (four Centaur T4002 engines), Brooklyn CS (Centaur T4002 and T4502 engines and Saturn T1202/T1302 engines), Wollert CS (Centaur T6102S engines and Saturn T1202/T1302 engines), Springhurst CS (Centaur T6102 engine), Euroa CS (Centaur T6102S engine) and Winchelsea CS (Taurus T7802S engine).

The turbines drive gas compressors that are used to compress gas which enables the pipelines to flow larger volumes to the market. The Melbourne market requires most of the compressors to be operating to meet the peak loads. They are operated by AEMO as the independent system operator of the VTS and maintained by APA.

The gas turbines require maintenance on a running hours' basis. Original Equipment Manufacturer (OEM) recommendations are for major overhaul at 32,000 hours for T4002 and T6102 engines. The turbines operate with clean dry gas under almost ideal conditions and have often been proven to operate successfully at longer hours than recommended. However, the Gooding engines are operated very frequently for short durations which often shortens the engine life. This operation style is increasing with the average hours per start of 23 has reduced to 21 since 2010. The GCS Unit 3 engine hours as of the 7th of December 2016 was 27,934.

The Wollert Compressor Station (station B) has two Solar Centaur 50 T6102S engines that operate almost continuously. The recently installed 400mm pipeline in parallel to the existing 300mm pipeline has increased the need for compression at Wollert. In addition, the station and pipeline is being reconfigured so the DN400 pipeline can operate to 10,200kPa-the maximum allowable operating pressure of station B. This is an increase from the constraint of 8,800kPa in the past. This reconfiguration will require the two C50 engines at Wollert to operate for longer durations.

The run hours of the existing engines with current usage rate and for 10% more usage predictions are shown below:

	December 2015	January 2018	January 2020	January 2021	January 2022
WCS 4	14760	20538	26315	29204	32093
WCS 5	14375	20002	25629	28442	31256
Increased Rate of 10%					
WCS 4	14760	21115	27471	30648	33826
WCS 5	14375	20565	26754	29849	32944

APA has an Alliance Agreement with the OEM (Solar Turbines Australia) which provides for reduced costs for overhaul of engines provided the assessment (performed by the OEM) indicates failure is not imminent. APA's policy is therefore to utilise periodic internal inspections of the machines and to utilise their observed condition to extend the overhaul intervals where possible or intervene to prevent premature failure. An overhauled engine, power turbine and auxiliary gearbox are returned in zero-hour condition, equivalent to new condition (turbine blades and wear parts such as discs, seals and shafts are re-worked or replaced as required). On occasion APA will utilise an exchange engine from the Solar fleet in order to reduce downtime as this service is available at the same cost.

4 Risk Assessment

TABLE 3: RISK RATING

Risk Area	Risk Level
Health and Safety	**Low**
Environment	**Low**
Operational	**Moderate**

Customers	**Moderate**
Reputation	**Moderate**
Compliance	**Moderate**
Financial	**Moderate**
Final Untreated Risk Rating	**Moderate**

The consequences of turbine failure are variable but all are disastrous. Failures can include a loss of containment of rotating parts, fuel gas which have fire and safety implications should an individual be present, or a significant mechanical failure without consequence escalation. For all scenarios the turbine will be inoperable for a significant period of time with significant cost escalation for repairs.

5 Options Considered

5.1 Option 1 – Do Nothing

The Do Nothing option would be to operate until failure. This approach would ignore the condition monitoring assessments. Due to the severity of the untreated risks including catastrophic failure this option is not a viable alternative.

Under these circumstances personnel safety would be jeopardised and the turbine would be off-line affecting pipeline deliverability. "Disposition repair" of turbines may be possible for turbine engines which may fail prematurely despite preventative maintenance program.

5.2 Option 2 – Complete Overhaul at Recommended Life

This option would be to operate until reaching 32,000 hours, regardless of the condition monitoring. The operating conditions are controlled by AEMO and not APA. The high number of starts compared to run hours is likely to produce the need to overhaul before 32,000 hours.

5.2.1 Cost/Benefit Analysis

- The benefits of this option are low for the following reasons:
  - Failure maybe earlier than 32,000 hours and thus introducing risks similar to the Do Nothing option
  - Overhaul maybe conducted earlier than necessary based on the condition of the turbine.

5.3 Summary of Cost/Benefit Analysis

The section should include a general overview of how the options compare and identify any options are not technically feasible.

TABLE 4: SUMMARY OF COST/BENEFIT ANALYSIS

Option	Benefits (Risk Reduction)	Costs
Option 1	Do Nothing	Indeterminate
Option 2	Complete Overhaul at Recommended Life	Greater than $4,598,991
Option 3	Condition Monitor (Preferred solution)	$4,598,991

5.4 Proposed Solution – Overhaul GCS Unit 3, Wollert Units 4 & 5

5.4.1 Condition Monitor

The proposed solution is to continue the inspection regime until need for complete overhaul.

5.4.2 Why are we proposing this solution?

Rotating plant require maintenance to ensure they continue to operate reliably. Gas turbine engines operate at high speed with very close machine tolerances and the necessity to remove the machines for manufacturer rebuild.

OEM recommendations are for major rebuilds at intervals associated with the running hours and whilst APA does extend this period, it requires performance monitoring and internal inspections to monitor the engine condition. The overhaul cannot be ignored as performance would degrade with additional running hours and ultimately component failure could result in catastrophic damage.

The operation of the plant isn't covered by specific Regulations. APA has a Service Envelope Agreement with AEMO wherein APA as owner and maintainer of the asset are required to use good practice.

5.4.3 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 the safety of plant and personnel and is of a nature that a prudent service provider would incur.
- Efficient – The overhaul work will be carried out by the equipment manufacturer. There is no viable alternative to the manufacturers overhaul. The expenditure can therefore be considered consistent with the expenditure that a prudent service provider acting efficiently would incur. Al expenditure is undertaken in conformance with the APA procurement policy.
- Consistent with accepted and good industry practice – Condition monitoring turbines is an accepted industry practice. The AER have approved turbine overhauls in the past.

5.4.4 Forecast Cost Breakdown

The costs associated with turbine overhaul are the following:

- Removal
- Overhaul by Solar Turbines
- Reinstallation and testing

TABLE 5: PROJECT COST ESTIMATE,

	Total
Internal Labour	**$1,088,311**
Materials	**$0**
Contracted Labour	**$3,510,680**
Other Costs	**$0**
Total	**$4,598,991**