Business Case – Capital Expenditure

Arc Flash Risk Mitigation
Business Case Number 309

1 Project Approvals

TABLE 1: BUSINESS CASE – PROJECT APPROVALS

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Approved By	Daniel Tucci	Victorian Asset Manager, Asset Management

2 Project Overview

TABLE 2: BUSINESS CASE – PROJECT OVERVIEW

Description of Issue/Project	Interim results of an Arc Flash Study highlighted an existing risk at a high portion of reviewed APA sites in line with the 2018 standard. This is when an arc fault develops while personnel are operating or working on high energy electrical equipment. This has been risk assessed as High risk (approved July 2021). To reduce risk to within the APA risk appetite short medium and long term work items have been identified.
Options Considered	The following options have been considered: Option 1: Do Nothing Option Option 2: Complete Arc Flash studies and implement recommendations
Estimated Cost	$1,250,000
Relevant Standards	Victorian Workplace Health and Safety Act and Regulation. Energy Safe Victoria and Worksafe Victoria have published a joint guideline document titled “Arc flash hazard Management” which details ESV and Worksafe’s expectations the risk of Arc flash assessed through completing Arc flash / fault study to IEEE 1584 or similar standards to determine the likelihood of personnel being exposed. Arc flash compliance has become part of ESVs audit and inspection program. APA has recently received a Non-Conformance from ESV associated with an incomplete arc flash study.

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)).
Key Stakeholders	The following are stakeholders involved in the successful delivery of this project: • Energy Safe Victoria • AEMO • Transmission Operations Personnel
Benefits to Customers and Consumers	The general public is not considered to be directly at risk from arc flash but an incident could result in disruptions to supplies for customers and consumers.

3 Background and Project Need

In 2020, APA conducted a national study at five APA sites to investigate the potential risks of electrical arc flash. Brooklyn Compressor Station has been identified as having a significant risk of electrical arc flash.

An arc flash is a serious hazard that has the potential to cause death, serious injury, damage to equipment and loss of electrical supply. An arc flash could be considered as an unexpected and violent, electrical short circuit in the air that produces an arc and associated explosions of gases and molten metal. In 2018, an arc flash incident resulted in the death of a worker and serious injury of another at the Yallourn power station.

WorkSafe legislation requires employers to adopt higher order controls and only select PPE when the risk of injury has been reduced, so far as is reasonably practicable. PPE may then be used to treat the residual risk. This is because PPE does not prevent injury but may reduce severity.

In many cases significant risk mitigation can be completed through changes to the trip settings of circuit breakers. This must be carefully balanced against making the breakers too sensitive and causing unreliability of equipment. In some cases, physical changes to the electrical boards are required for adequate safety of operations personnel.

Further work is currently on going to review the risk of arc flash and determine the required actions across APA's regulated and unregulated assets.

APA VTS has identified the need to address the latent Arc flash problem on VTS assets to reduce safety risks to workers. The risks of arc flash are greatest for personnel working in close proximity to switch boards and motor control centres.

There is a need to address to arc flash issue on the VTS to provide safety to workers at a level of regulatory compliance, industry best practice and corporate risk tolerance.

Why are we proposing to address the issue now?

APA became aware of these risks in early 2021 after performing a pilot assessment of five sites in late 2020. The assessment found that a majority of sites had significant arc flash risks. While these sites had arc flash protection devices installed, the settings remained at factory defaults that were insufficient to provide adequate protection.

Several standards relating to arc flash were updated over the course of 2018, changing how arc flash is modelled and assessed by industry. Additionally a review of APA design standards is underway such that any new equipment installed will be compliant as soon as it becomes an operational asset.

Have we commenced the project in the current period?

Due to risk level involved APA, has commenced assessments of these sites and mitigation of these risks in the current access arrangement period and will be continuing these works into the 2023 -2027 period. APA VTS was not aware of this problem in 2017 when preparing the submission for the current access arrangement. Therefore, investment in the arc flash program has been prioritised over other forecast programs.

What are the relevant technical standards relating to the issue?

There are a number of standards relevant to arc flash.

- AS/NZS 3000 – Electrical Installations (Wiring Rules)
- AS/NZS 61439 – Low-voltage switch gear and control gear assemblies
- AS IEC 62271 – High voltage switch gear and control gear assemblies
- AS/NZS 4836 – Safe working on or near low voltage electrical installations and equipment

The primary standard used for assessment and mitigation of arc flash are US based:

- IEEE 1584:2018 – IEEE (Institute of Electrical and Electronics Engineers) guide for Performing Arc Flash Hazard Calculations (updated November 2018)
- NFPA 70E: 2018 Electrical Safety in the workplace

What are the relevant regulations relating to the issue?

The effects of arc flash on personnel are covered under the following regulations:

- Victorian OH&S Act 2004
- Electrical Safety Act 1998
- OH&S Regulations 2018
- Electrical Safety (Installation) Regulations 2009
- Electrical Safety (General) Regulators 2019

Specifically, regulations 501 and 502 of the Electricity Safety (General) Regulations 2019 outline the duties of owners and operators of high voltage and complex installations. These regulations include, but are not limited to, the requirement that owners and operators must ensure that the electrical installation is safe and maintained and operated safely.

This does not diminish or underestimate the need to manage potential arc flash hazards for other installation as under the Victorian OH&S Act (2004) an employer must provide and maintain a working environment that is safe and free of risk to health, so far as reasonably practicable.

Energy Safe Victoria and Worksafe Victoria have published a joint guideline document titled "*Arc flash hazard Management"* which details ESV and Worksafe's expectations to have assessed the risk of Arc flash through completing Arc flash / fault study to IEEE 1584 or similar and determine the likelihood of personnel being exposed.

Arc flash compliance has become part of ESVs audit and inspection program with APA has recently received a Non-Conformance from ESV associated with an incomplete arc flash study.

4 Risk Assessment

TABLE 3: RISK RATING

Risk Area	Risk Level
Health and Safety	**HIGH**
Environment	**N/A**
Operational	**LOW**
Customers	**N/A**
Reputation	**N/A**
Compliance	**LOW**
Financial	**N/A**
Final Untreated Risk Rating	**HIGH**

The risk covered under the various categories were considered as below

Health and safety:
Permanent injury and/or death of more than one employee / contactor. General public are not considered to be directly at risk from arc flash.

Operational & Compliance:
Primary impact to operational capability comes from either additional downtime in the event of an arc flash to allow regulatory investigations to be completed, or more time with sites completely offline for maintenance. This requires having the electrical grid connections removed from the station before and re-instated again after work.

5 Options Considered

5.1 Option 1 – Do Nothing

This option would accept the current high health and safety risk, and not progress with any further investigation or rectification work. Where effective at reducing safety risk, complete disconnection of the electricity grid from asset before undertaking any maintenance works could be completed. This would not be a viable nor practicable option for unplanned outages of equipment.

5.1.1 Assessment

This option would result in APA operating in breach of its requirements under the Workplace Health and Safety Act and Regulation and may be directed to cease operation of the equipment by ESV or Worksafe due to unacceptable risks.

APA would be exposed to likely regulatory penalties, civil damages, criminal charges, reputational and customer losses along risk of injury and death to employees.

5.2 Option 2 – Complete Arc Flash studies and implement recommendations

Option 2 is the completion the site validation and arc flash studies as per the recommendations of the various regulatory bodies and standard discussed in section 3. Sites will be identified and assessed using a risk based approach.

The mitigation measures are likely to range from setting changes to existing equipment (low cost) to additional equipment, replacement of equipment with similar remotely operated equipment or complete replacement of electrical switch boards.

The recommended mitigation measure from the studies would be optimised and implemented to ensure lowest cost solution for the required risk reduction.

The total number of sites required to be assessed and mitigated is currently unknown, particularly due to the ESV direction to review arc flash from battery systems.

5.2.1 Assessment

This option maximises risk reduction vs costs by applying a risk based approach and allowing learning from the highest risk sites to optimise the process for later sites and also ensure that sites aren't assessed or changed without being necessary.

This also allows APA to operate the assets in a safe and compliant manner, minimising risk to staff and extended outages.

An estimate of $1.25m has been allocated for this option due to the number of VTS sites being of a significant age, some may require the more intensive risk mitigation of physical changes to electrical cabinets.

5.3 Assessment Summary

TABLE 4: SUMMARY

Option	Benefits (Risk Reduction)	Costs
Option 1	Do Nothing	-
Option 2	Completed Arc Flash studies and implemented recommendations to avoid high risk operating conditions	$1,250,000

5.4 Proposed Solution

5.4.1 What is the Proposed Solution?

The proposed solution is option 2 as this meets our regulatory requirements and is in line with prudent operation.

5.4.2 Why are we proposing this solution?

APA must complete the arc flash and mitigate risks to as low as reasonably practicable to meet legal and safety obligations. Until the arc flash studies are completed the detail of what works are required and associated costs to complete estimated based on the information available.

There are no feasible alternatives to completion of the Arc Flash studies. The studies are required to understand the energy / risk per site. Once the studies are complete various options to mitigate the risk can be reviewed for best risk reduction per dollar spent.

5.4.3 Consistency with the National Gas Rules

Consistent with the requirements of Rule 79 of the National Gas Rules, APA considers that this capital expenditure is:

- Prudent – The expenditure is necessary in order to maintain and improve the safety of services and maintain the integrity of services to customers and personnel and is of a nature that a prudent service provider would incur.

- Efficient – The selection of the appropriate timing for each facility uses a consistent and transparent decision process that balances risk and operating context to ensure that the best solution is implemented. Progress to date has demonstrated specific expertise in completing the work in a safe and cost effective manner. The expenditure can therefore be considered consistent with the expenditure that a prudent service provider acting efficiently would incur.

5.4.4 Forecast Cost Breakdown

Due to the arc flash studies yet to be completed a detailed cost forecast cannot be provided at this stage. In general, the hierarchy of implementation is likely to be:

1. Implementation of settings changes to existing circuit breakers (faster tripping) to limit arc flash energy up to the point where faster/more sensitivity would result in spurious activation and system unreliability. These changes are primarily internal labour and low cost.

2. Changes to existing electrical cabinets or equipment to lower the arc flash energy a person is exposed to. This may be shields between compartments and/or exchanging manually controlled components for automated components. These changes would be very specific to the location and difficult to cost in advance of the study. Such changes are likely to be moderate cost with a mix of materials and internal labour.

3. In some cases, there may be no way to reduce the risk to an appropriate level without making significant changes or replacement of the electrical switchboard enclosures. These changes are generally the most invasive and higher cost with a significant component of materials and contracted labour.

APA assumes that most sites will require some form of changes to the protection circuit breakers with a limited number of equipment changes and a very small number of electrical cabinet changes. APA anticipates that all of the high-risk sites will have had the studies completed by the start of calendar year 2023 and that all mitigation works will be completed by the end of the access arrangement period (Dec 2027).

TABLE 5: PROJECT COST ESTIMATE,

	Total
Internal Labour	**$150,000**
Materials	**$500,000**
Contracted Labour	**$600,000**
Other Costs	**$0**
Total	**$1,250,000**

The estimate will be subject to the findings from the Arc Flash Study (scheduled 2021) but initial costings have been provided and the intent to direct $250,000 per year to address the identified risks.

6 Acronyms

Acronym	Definition/Description
AEMO	Australian Energy Market Operator
AGA	Australian gas association – Type B compliance governing body
API	American Petroleum Institute – publisher of standards

CHAZOP	Control system HAZOP – study of the control system functions to identify logic vulnerabilities
ESD	Emergency shutdown – control system-initiated shutdown designed to prevent incident escalation if operating parameters are breached
ESV	Energy Safe Victoria
HAZOP	Hazard and operability study
HMI	Human machine interface
ILI	Inline inspection – pipeline internal inspection
OEM	Original Equipment Manufacturer
RA	Risk Assessment
RBI	Risk Based Inspection – a process used to prioritise maintenance or inspection activities based on risk of failure.
SIL	Safety Integrity Level – an assessment used to rank control systems by their ability to fail safely
SMS	Safety Management Study
VTS	Victorian Transmission System