CITIPOWER

RIT-D: Russell Place supply area

Non Network Options Report

Notice of Determination under clause 5.17.4(c) of the National Electricity Rules

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CitiPower

03/10/2019

Contents

1 Summary

This document is CitiPower's notice of its determination that there are no credible non-network options to address all or part of the identified need at Russell Place (RP) zone substation. CitiPower's determination is made under clause 5.17.4(c) of the National Electricity Rules and is published pursuant to clause 5.17.4(d). In accordance with those provisions, CitiPower will not be publishing a non-network options report in relation to the proposed works at RP zone substation.

In summary, our reasons for this conclusion are:

- There is no opportunity to reduce the required assets and associated works at RP zone substation by partially reducing peak load through demand management;
- due to its location within the Melbourne CBD, an embedded generation or demand response option will not be a feasible or cost effective long term solution.

1.1 The need for intervention

The RP zone substation is one of the earliest zone substations to supply the Melbourne CBD. It was first commissioned in 1889 as a DC station and was later rebuilt (1940-42) as a 22kV / 6.6kV zone substation. The zone substation primarily supplies commercial customers, including some high profile customers such as the Melbourne Town Hall.

The zone substation has multiple assets including; sub-transmission cables, transformers, circuit breakers and auxiliary equipment at the end of their service life. These assets will present an increased operational and safety risk if they continue in service into the future. The zone substation building has been inspected and is showing signs of deterioration. To secure the structural longevity of the building, repair work is required to mitigate and reinforcement existing walls within the basement of the building. Limited repair work can be undertaken while the site is live.

The RP distribution network operates as an islanded 6.6kV network surrounded by the 11kV meshed CBD network. There are only limited contingency transfers to an adjoining zone substation via 6.6kV/11KV auto transformer switching station; however there is a risk that should a major outage occur, customers will be left without electricity supply for a sustained period of time until emergency repairs are made.

In order to efficiently manage the risks to safety, reliability and security of supply associated with the deterioration of the assets at RP, the transformers should be retired by 2021. In absence of action to reduce the load or replace the assets, it will not be possible to continue to supply all the customers from RP.

1.2 Possible solutions to address the identified need

The possible network solutions to address the identified need are:

- decommission RP in 2021, and transfer all load from RP via new 11kV distribution feeders to Waratah Place (WP) zone substation and upgrade the RP distribution network to 11kV;
- decommission RP in 2021, and transfer all load from RP via new 11kV distribution feeders to WP via step down transformers to retain the RP 6.6kV distribution network; and
- replace all of the assets in RP and upgrade the distribution network from 6.6 to 11kV.

CitiPower will now prepare and publish a draft project assessment report in relation to the RP zone substation project.

Any questions regarding this notice or requests for further information should be directed to:

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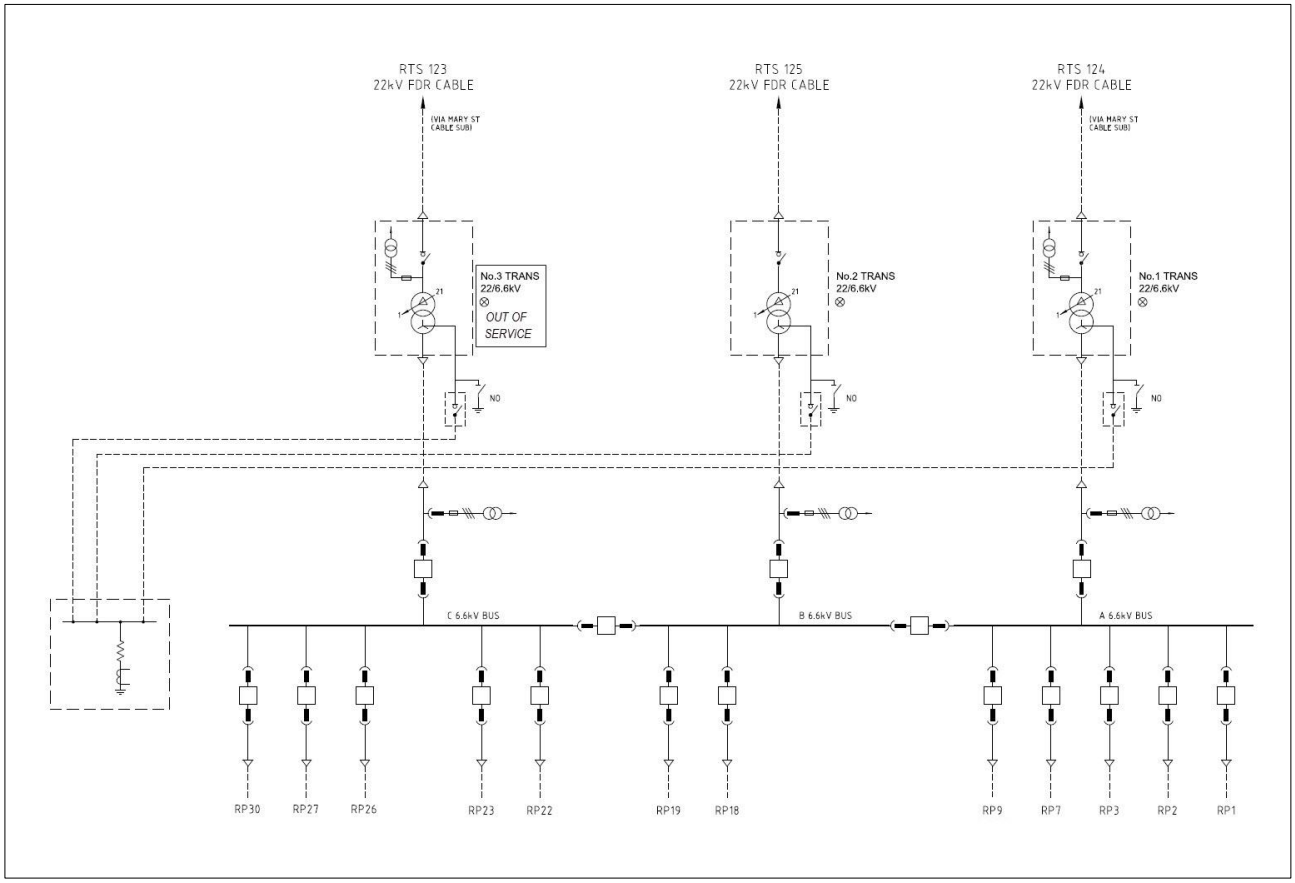
2 Background

2.1 Zone substation RP configuration

The Russell Place (RP) zone substation currently supplies a two block area of the Melbourne CBD and has been in service for more than 65 years. The substation is located below ground with a third party owned office and residential building above, sharing its foundation with the zone substation. The zone substation primarily supplies commercial customers, including some high profile customers such as the Melbourne Town Hall.

RP zone substation currently has three 22kV / 6.6kV 10MVA transformers with a full station N – 1 rating of 18.9MVA during the summer. All three transformers at RP are radially supplied from Richmond Terminal Station (RTS), although the RTS – RP123 sub-transmission line supplying the No.3 transformer is currently out of service due to a substantial fault. Difficulties in gaining access to the section of cable where the failure has occurred have impaired the repair work required to put the cable back into service. As no customer load was placed at undue risk by this outage the cable has been switched out of service.

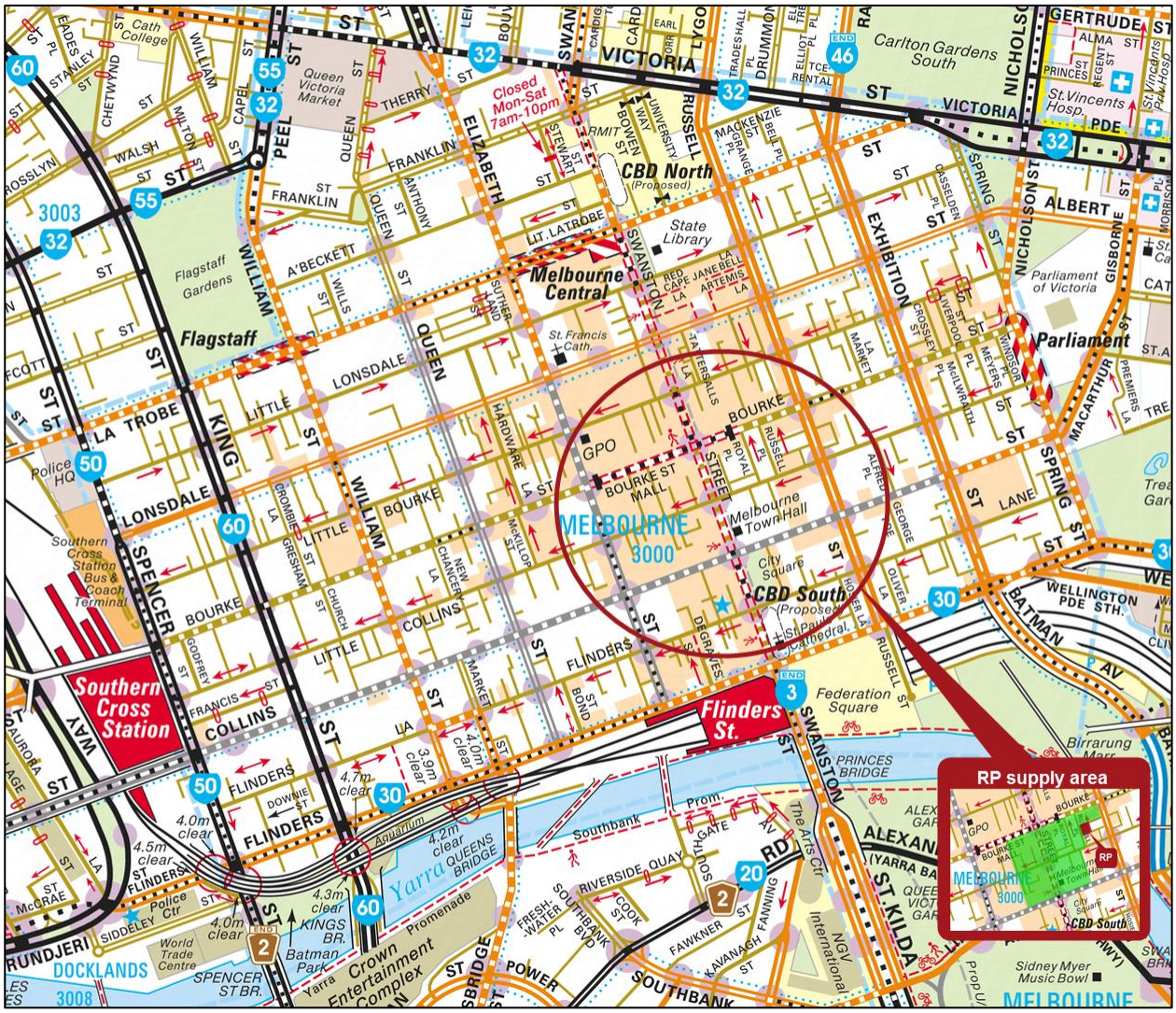
Figure 1 RP single line diagram



2.2 Location

RP is located on Russell Place lane way and supplies electricity to a total of 1,027 customers within the Melbourne CBD. Figure 2.2 shows the approximate location of the zone substation and distribution network area in the within the CBD.

Figure 2 RP zone substation and distribution network coverage



Base map licensed by OpenStreetMap © and contributor Melways under the Open Data Commons Open Database License

2.3 Demand forecast

RP zone substation load profile is forecast to remain a summer peaking zone substation. The load is significantly commercial with over 80% of customers in this category and most of the remaining demand is from residential customers being the next largest category at 18%.

The 50% Probability of Exceedance (PoE) demand forecast for summer and winter is shown in the figure 3 and figure 4 respectively.

Figure 3 RP zone substation summer forecast demand

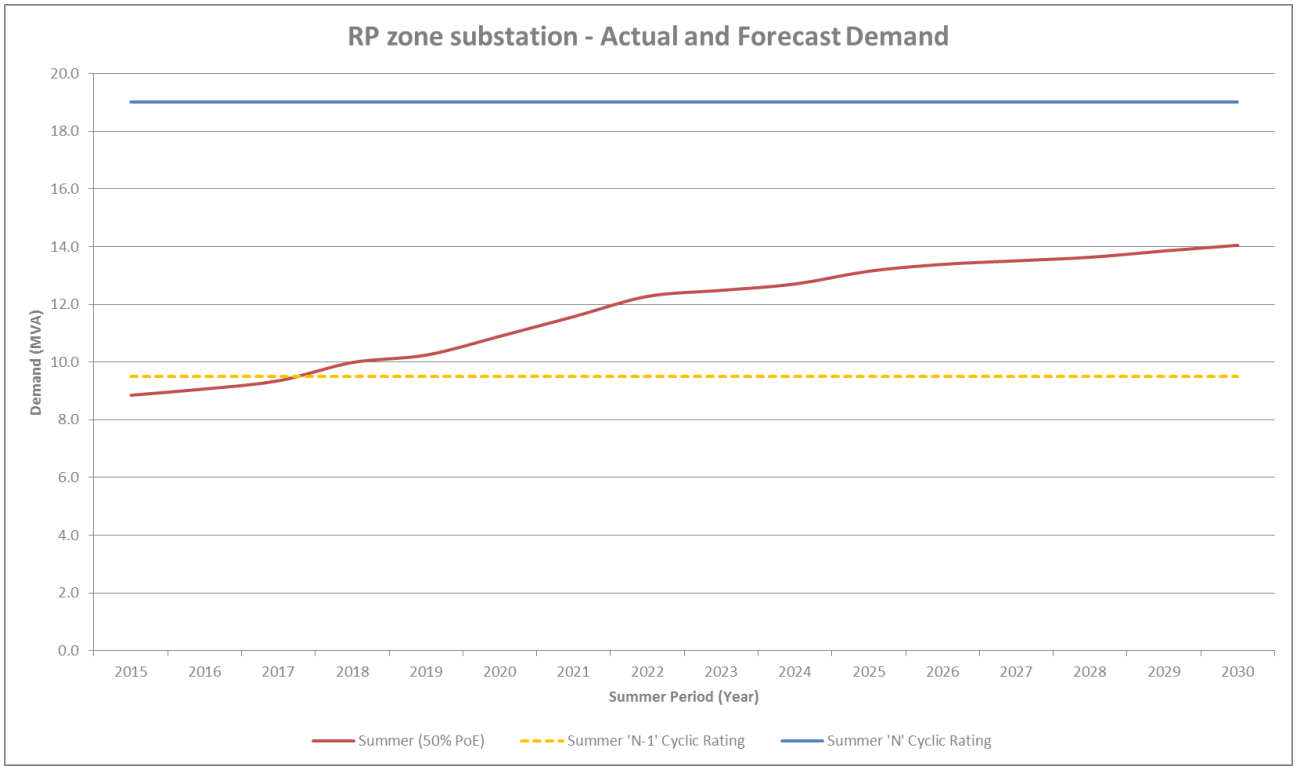
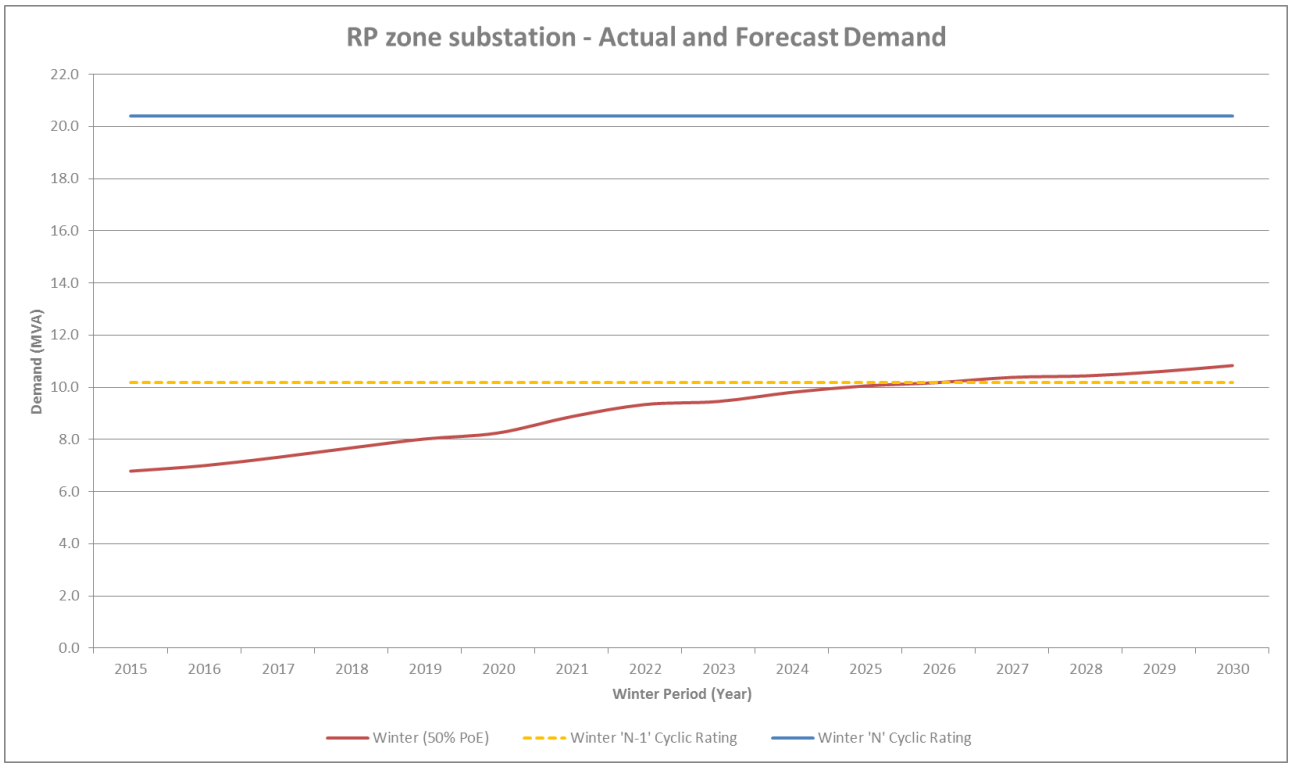


Figure 4 RP zone substation winter forecast demand



2.4 Load transfer capacity to adjacent substations

The 11kV network surrounding the RP 6.6kV network is supplied from nearby Flinders Ramsden zone substation (FR) McIlwraith Place zone substation (MP) and Celestial Avenue substation (WA). The new Waratah Place zone substation (WP) will also supply adjacent areas once it is commissioned into service in 2020.

The load transfer capability for RP to nearby zone substations is limited due to its 6.6 kV distribution voltage. During peak demand an estimated maximum contingency transfer capacity of 4.0 MVA is available via a 6.6/11 kV auto transformer switching station to a standby 11 kV feeder. The standby feeder can only be used as an operational response to partially mitigate the impact of an outage at RP zone substation.

3 Identified need

3.1 Overview of the identified need

The following issues have been identified at Russell Place (RP) zone substation:

- Asset Condition: Transformers and switchgear in the substation date from 1952-61. One of the three transformers on site was removed from service in 2015 due to safety concerns and the remaining equipment is in poor condition requiring more frequent maintenance.
- Building Condition: The inner support walls of the substation have been inspected and show signs of accelerated corrosion to the steel reinforcement. To secure the structure of the building for the future the existing interior façade walls require demolition to allow corrosion mitigation and reinforcement to take place. This work cannot be undertaken while the site is live and with the equipment currently on site in place.

Multiple assets including transformers, circuit breakers and auxiliary equipment are at the end of their service life, with limited spares making it difficult to repair should a fault occur. These assets present an increasing operational and safety risk if they continue in service into the future.

As there is limited load transfer capability between zone substation RP and the adjacent substations, within the CBD network; there is a risk that should a major outage occur at zone substation RP, customers will be left without electricity for a sustained period as we will be unable to restore supply to all customers until repairs are made and existing assets returned to service or replaced.

In addition, in the event of a catastrophic failure of a transformer or circuit breaker, there is a risk of serious injury to staff and major damage to plant and buildings. Significant time may be required to restore or replace assets to enable restoration of supply. The basement location increases the consequence of a catastrophic failure and while the likelihood is low there is potential to cause damage and/or disruption to the CBD buildings above and adjacent to the substation.

The identified need, therefore is to address the increasing risks to safety and reliability of supply associated with the deterioration of the assets at zone substation RP. This ensures we continue to comply with our obligations in the following regulations:

- section 98 of the Electricity Safety Act[1]
- clauses 3.1 and 5.2 of the Victorian Electricity Distribution Code.[2]

Section 0 below provides an overview of our approach to assessing asset condition and risk. Sections 3.3 to 3.5 then provide further information on the condition of the plant at RP, and the need to address the risks associated with the deteriorating condition of these assets.

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[1] Under section 98 of the Electricity Industry Safety Act, CitiPower (as a major electricity company) must design, construct, operate, maintain and decommission its supply network to minimise as far as practicable:
- the hazards and risks to the safety of any person arising from the supply network; and
- the hazards and risks of damage to the property of any person arising from the supply network.

[2] Clause 3.1 of the Victorian Electricity Distribution Code requires us to manage our assets in accordance with the principles of good asset management. Under this provision, we must, among other things, develop and implement plans for the management of our assets to minimise the risks associated with the failure or reduced performance of assets. Under clause 5.2, we are required to use best endeavours to meet customers' reasonable expectations of supply reliability.

3.2 Asset condition

We apply the condition based risk management (**CBRM**) methodology to certain plant-based asset classes, namely transformers and HV circuit breakers. The CBRM model is an asset risk assessment algorithm that considers a range of inputs including:

- asset condition assessment data, such as transformer oil condition;
- environmental factors, such as whether the assets are located indoors or outdoors, or coastal areas; and
- operating factors, such as the load utilisation, frequency of use and load profiles that the asset is supplying.

These factors are combined to produce a health index for each asset in a range from 0 to 10, where 0 is a new asset and 10 represents end of life. The health index provides a means of comparing similar assets in terms of their probability of failure.

We closely monitor assets with a health index in the range 5 to 7 to determine options for intervention, including replacement or retirement, in the context of energy at risk. Interventions are evaluated and planned when asset health index exceeds 5.5 and intervention is prioritised when asset health index exceeds 7.

A health index profile gives an immediate appreciation of the condition of all assets in a group and an understanding of the future condition of the assets.

As part of the CBRM process, the consequence of failure of the asset is also calculated. The consequence of failure consists of four elements:

- network performance;
- safety;
- financial; and
- environment.

The risk is calculated by combining the probability of failure of the asset and the consequence of failure of the asset. CBRM is used to calculate how the risk is likely to change in future years. In this way, the CBRM analysis provides:

- a preliminary indication of the likely optimum replacement time of an asset;
- a foundation or starting point for further detailed economic assessment to determine the optimum timing of intervention action.

As already noted, the assets at zone substation RP are aged and in poor condition. Our latest CBRM analysis indicates that the optimum year to retire the deteriorating assets at zone substation RP is likely to be around 2021.

3.3 22 kV sub-transmission cables

The 22kV cables supplying the RP zone substation from the Richmond Terminal Station (RTS) are of belted paper lead type cable construction installed in early 1950s.

As of November 2014, RTS-RP123 22kV HV UG cable has failed in the section of cable behind the Mary Street Cable Station and the Sound Wall isolating the Monash freeway. This cable is direct buried under the sound wall and in practical terms cannot be accessed for repair. This cable was supplying the transformer no.3 at RP Zone substation.

RTS-RP125 22kV HV UG cable (supplying transformer no.2) had previously failed in the section of cable behind the Mary Street Cable Station and the Sound Wall isolating the south eastern freeway. To maintain the supply at the time of the failure, the section of failed cable was bypassed by transitioning the RTS 152 cable to the RTS 125 breaker at RTS due to the access difficulty for repair.

The CitiPower network is having similar cable construction types in 22KV system that had failed in past at the similar service life. Those failures had been mainly at cable sections rather than at joints which indicates the cables have reached end of life. (eg .Sub C had four failures from 2007 to 2014).

3.4 Transformers and HV switchgear

The RP zone substation is a three transformer substation. The transformers 1 & 2 have been installed in 1952 and the transformer 3 has been installed in 1961. Currently, the No. 3 transformer is out of service since the 22KV sub transmission cable (RTS 123) failed in 2014.

The CBRM model analysis has determined that the transformer 1 & 2 currently have the health indices (HI) of 6.6, and projecting HI at 7.5 in next 5 years that is above the predicted end of life.

In current condition, all three transformers are indicative of increased insulating oil acidity that accelerates insulation paper degradation and reduces the oil properties as well. The transformers are evident of developing internal corrosion and sludge build up, that could potentially lead to an internal arcing due to degraded electrical insulation at the proximity of live components.

Therefore, the transformers 1 & 2 are in need of a major refurbishment including an oil reconditioning and a thorough internal condition assessment that may require removal of the f transformers out from the substation. The existing lifting facility and the building structural condition of the substation have been assessed and recommended to improve as discussed in section 2.1.

In regards of the 6.6KV switch gears, the current CBRM model has determined that all the Rayrolle circuit breakers have reached health index (HI) of 7.0 and the projected HI will be 8.00 in next 5 years. According to the CBRM health index grouping, HI=7.0 means the asset has reached the end of life and need prioritising to retire or replacement of the asset.

The other considerations that are relevant to the timing of retirement or replacement of the breakers include:

- due to the age, slow operation of a circuit breaker during fault clearance may result in damages to the network and potential outage to the customers;
- spare parts are no longer available for aged major plant components. Should any failure of a critical component requires re-engineering of the part and will delay to restoration;
- the 6.6KV switch board is installed with insulation compound filled bus and cable box arrangements that leads to difficult and time consuming maintenance and testing procedure. In event of a damage to the bus, the repair will utilise significant amount of repair time leading to alternative arrangements to the customers for the repair period;
- the CP/PAL asset strategy is to reduce the oil filled type circuit breaker population and transition to Vacuum or SF6 type switch gears to support the reliability of the network and to improve personnel safety;
- the old HV switchboard is not arc fault contained or vented, therefore should an arc failure of the switchboard or a circuit breaker will impose a safety risk to personnel and other assets in the station; and
- should a catastrophic failure of a bus tie circuit breaker may result in two bus outage disrupting supplies to the customers. Due to the current status of the substation (with transformer 3 out of service) bus A - B tie breaker failure will lose the whole substation.

3.5 Auxiliary equipment

The RP zone substation has a significant number of old style electro -mechanical protection relays and secondary equipment which are limited in function and creates difficulty of replacement due to the obsolescence. The existing protection relies on ageing supervisory with an increased risk of protection failure. The failures will require installing modern equipment and modification of existing system to interface with new equipment.

Also, the secondary equipment is installed on asbestos boards that require removal to eliminate personnel exposure to asbestos and to improve the safety standard across the sites. Isolation of protection system and new installations according to current safety standards will be expensive and would require an outage of bus sections to implement.

4 Potential credible options

This section provides a description of the options considered to address the identified need.

4.1 Network options

Table 4.1 provides a description of the credible network options that have been identified as feasible to address the identified need in comparison to a 'do nothing' option. In our draft project assessment report, the assessment of these options will include a comparison of the net economic benefits relative to a do-nothing approach.

Table 4.1 Network options ($million, $2019)

	Network option description	OPEX Cost	CAPEX Cost
0	**Do nothing** The scope of work includes: • ongoing routine maintenance • estimated building structural works* • incidental capital work to replace end of life minor components	$1.05*	$0.0
1	**Convert RP to 11kV and continue to provide 6.6kV distribution** The scope of work includes: • remove the existing transformers and install a two 11/6.6kV (20MVA) transformers at RP • remove the 6.6kV switchboard and install new two section 6.6kV switchboard and transformer breakers • install 11kV switchboard at RP for four 11kV feeders and two transformer breakers • install four dedicated 11kV feeders directly from WP substation • replace all secondary systems and auxiliary equipment • decommission the 22kV transmission feeders • building structural and integrity works to match expected new equipment life (>50 years) This option eliminates the need for capital expenditure to upgrade 6.6kV substations to 11kV however the islanded 6.6kV network would be retained indefinitely, limiting operational flexibility, and backup capability to meet future demand growth.	$0.025	$15.7M
2	**Retire RP and offload to WP, remove all equipment** The scope of work includes: • decommission RP and remove all equipment • install four dedicated 11kV feeders from WP substation • upgrade all 6.6KV distribution substations and associated works to 11kV • decommission the 22kV transmission feeders • building structural and integrity works necessary for a decommissioned site This project aligns with our strategy to replace the 22 kV transmission with 66 kV as well as upgrading the associated 6.6 kV distribution network to 11 kV.	$0.025	$12.5M

3	**Like for like rebuild of RP zone substation and 22kV transmission cables** The scope of work includes: • remove the existing transformers, circuit breakers and all secondary and ancillary equipment • install two 22/6.6kV (20MVA) transformers • install two section 6.6kV switchboard • replace all secondary and ancillary equipment • replace all 22kV sub transmission cables from RTS • building structural and integrity works to match expected new equipment life (>50 years) This option eliminates the need for capital expenditure to upgrade 6.6kV substations to 11kV however the islanded 6.6kV network would be retained indefinitely and limits operational flexibility, backup capability and ability to meet future demand growth.	$0.025	$34.7M

4.2 Other network option(s) considered but rejected

Table 4. describes other network options we considered, but rejected because they were either technically or economically infeasible.

Table 4.2 Other network options considered but rejected

	Other network option description
4	**Transfer RP to nearby zone substations McIlwraith Place (MP) or Flinders Ramsden (FR)** The scope of work includes: • extend four new 11 kV feeders from MP or FR to tie into the RP distribution network • replace the 6.6 kV distribution transformers with 11kV rated transformers • decommission zone substation RP This option was rejected as both zone substations don't have spare circuit breakers to cater for the load transfer from RP. It is not currently possible to extend the existing switchboards without major redevelopment at both sites. This means additional offload and transfers would be required to make circuit breakers available.
5	**Rebuild RP** The scope of work includes: • decommission existing transformers and switchgear at RP • Undertake building upgrades to enhance the structural integrity of the building to cater for new transformers and switchgear • install two 66 kV cables from RTS, new 66 kV Gas Insulated Switchgear (GIS), two transformers (20/27 MVA), 11kV switchboard and auxiliary equipment Although this option aligns with our strategy to replace the 22kV sub-transmission network with 66 kV and convert the remaining 6.6 kV distribution network within the CBD, it was rejected as it is similar to option two and three in table 4.1. For the rebuild works to occur, RP customers would be transferred away to WP zone substation whilst construction work takes place and structural building work is completed to accommodate larger capacity transformers. With its close proximity to the new Waratah Place (WP) zone substation, CitiPower does not foresee the requirement to build an additional high capacity zone substation in the localised area of the CBD network.

5 Consideration of non-network options

In the case of the identified need at the Russell Place (RP) zone substation, we have concluded that there are no credible non-network options for the following reasons:

- there is no opportunity to reduce the required assets and associated works at RP by partially reducing peak load through demand management;
- embedded generation would not be cost effective in this CBD location.

Our reasons are based on a consideration of the following characteristics of the supply arrangements at RP zone substation:

- significant commercial and residential apartment loads are currently served by RP;
- the commercial customers currently served by RP have high expectations regarding the reliability of electricity supply within the Melbourne CBD;
- existing limitations on the distribution network fault levels restrict the size and operating ability of generator connections on the 6.6kV CBD network; and
- the cost of embedded generation exceed the cost of the preferred network option, and there is in any event, limited space for implementing a local generation option large enough to meet current and forecast demand within the current site.

In considering the feasibility of generation options, CitiPower investigated an indicative estimate on the cost of a hypothetical stand-alone gas-fired generator that would provide a level of supply reliability comparable to the network options. It was found that the high level annualised capital cost of a stand-alone generation option was higher and therefore unfavourably when compared to the network options and excludes a number of key elements such as the cost and availability of a site suitable for such a generator within the CBD. As these were only likely to further increase the costs of this alternative option no further consideration of this option was made.

6 Determination

For the reasons set out in this notice, pursuant to clause 5.17.4(c) of the Rules CitiPower has determined that there are no credible non-network options to address the identified need at RP zone substation. Therefore, in accordance with clauses 5.17.4(c) and (d) of the Rules, CitiPower will not be publishing a non-network options report in relation to the proposed works at RP zone substation.

CitiPower will prepare and publish a draft project assessment report in relation to the RP zone substation project, in accordance with clause 5.17.4(i) of the Rules.