RIT-D: Little Queen Supply Area – Final Project Assessment Report

CitiPower Pty Ltd

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1. Executive Summary

1.1 Summary

CitiPower is a regulated Victorian electricity distribution business. It distributes electricity to around 349,000 homes and businesses in Melbourne's central business district (CBD) and inner suburbs.

The CitiPower electricity distribution network consists of more than 58,207 poles and over 7,525 kilometres of overhead lines and underground cables. Electricity is received via 70 sub-transmission lines at 33 zone substations, where it is transformed from sub-transmission voltages down to distribution voltages.

The area of CitiPower's electricity distribution network that is the subject of this Regulatory Investment Test for Distribution (RIT-D) is the Little Queen Zone Substation (LQ) supply area (i.e. LQ supply area).

LQ is supplied by three sub-transmission circuits originating from the West Melbourne Terminal Station (WMTS) via Victoria Market (VM) and Little Bourke Street (JA) zone substations. This zone substation supplies part of the central Melbourne CBD and comprises three 60 MVA transformers operating at 66/11 kV, connected to three double busbar 11 kV busses in a compound insulated metal clad switchboard.

LQ was constructed in the early 1970s and most of the original substation equipment remains in service. This includes the existing compound-insulated double bus switchboard and bulk oil-filled switchgear which was designed with no arc fault containment, presenting a safety risk to our operators and personnel accessing this site. The switchboard and secondary systems at LQ are deteriorating in condition and are at end of life.

1.2 Purpose

This report has been prepared by CitiPower in accordance with the requirements of clause 5.17.4, paragraph (r) of the National Electricity Rules (NER) version 217.

The purpose of this report is to identify the preferred option to address the identified need, associated with the network safety and reliability limitations within the LQ supply area. This report has been prepared following the publication of the Notice of Determination Report and consultation on the Draft Project Assessment Report (DPAR), and represents the final stage of the RIT-D process.

The preferred option involves a renewal of LQ's secondary systems and 11 kV switchboard within the existing substation building. This option addresses both the safety need and reliability need. The cost of the preferred option is $28.96 million (Real, 2024) and is required to be commissioned by November 2027.

1.3 Notice of Determination Report

On 19 September 2024, CitiPower published a Notice of Determination Report in accordance with clause 5.17.4, paragraphs (c) and (d) of the NER. The purpose of that report was to present the potential credible options considered, and to explain the reasons for concluding that there would unlikely be any potential credible non-network or Standalone Power System (SAPS) options (or any combination of those options, or with a network option) that could adequately and economically address the identified need within the LQ supply area.

1.4 Draft Project Assessment Report

On 19 September 2024, CitiPower published a DPAR in accordance with clause 5.17.4, paragraph (i) of the NER. The purpose of that report was to present the economic evaluation of the credible options and to identify the proposed preferred option that satisfies the requirements of the RIT-D for the identified need within the LQ supply area. No submissions were received during the DPAR consultation period.

1.5 Final Project Assessment Report

Following publication of the Notice of Determination Report and at the conclusion of the DPAR consultation, CitiPower is required to prepare and publish a Final Project Assessment Report (FPAR), as required under NER clause 5.17.4, paragraph (o). The NER requires that the FPAR includes matters detailed in NER clause 5.17.4, paragraph (r)(1), summarised as follows:

- Provide background information on the network servicing the LQ supply area and its limitations;
- Describe the need which CitiPower is seeking to address, together with the assumptions used in identifying that need;

- Describe the credible options that are considered in this RIT-D assessment;
- Explain the materiality of each class of market benefit;
- Describe the methods used in quantifying each material market benefit;
- Quantify costs, high-level cost breakdowns, and material market benefits for each of the credible options;
- Present the results of a Net Present Value (NPV) analysis, with explanatory statements regarding the results;
- Identify the preferred option, its costs, optimum timing and its technical characteristics; and
- A summary of any submissions received on the DPAR and the responses to those submissions.

1.6 The Identified Need

The LQ 11 kV switchboard is non arc fault contained and consists of three compound insulated double bus sections with fifty-six panels containing mainly J18 and J22 bulk oil circuit breakers with five retrofitted Siemens 3AH vacuum circuit breakers installed in 2005 for the capacitor banks.

The insulation of the LQ 11 kV switchboard has been deteriorating over the last several years with an online partial discharge (PD) monitor system installed in November 2017. A number of minor PD sources have been identified and rectified, however these repairs are not a long-term solution as other PD sources detected from within the bus by the online monitoring system, indicate that imminent replacement is warranted. These other PD sources are not possible or feasible to repair and are therefore terminal to the switchboard.

Switchgear and cables condition monitoring show that increasing PD in both compound and solid insulation is a problem and has been on a steady increase with two to three new locations across the entire switchboard per year for the last five years. For every repair that is undertaken by CitiPower, two new PD locations commence. Due to age of this equipment, new replacement parts are unavailable for this switchboard type. Furthermore, failure of this equipment would likely be catastrophic, resulting in explosion and fire. With four new PD locations detected in the last four months, the deterioration rate is accelerating. Active PD sources now impact more than 47% of the switchboard panels - evenly distributed across all busses.

The original secondary assets at LQ including electromechanical protection relays are also experiencing condition deterioration, and are technically obsolete with limited spares, and no longer supported by vendors. This poses a serious safety and reliability risk for the ongoing fault protection coverage of LQ and its distribution network. Furthermore, the poor condition of the protection devices that are supposed to be protecting this poor condition switchboard, could result in a catastrophic failure, if a simultaneous switchboard internal fault coincides with a protection relay failing to operate.

The asset management need at LQ is to maintain a safe and reliable supply of electricity to customers in the LQ supply area. This recognises the risks associated with the existing switchboard, including the increasing probability, severity and consequence of failure—for example[1] :

- deterioration in compound-filled assets is typically monitored by measuring partial discharge activity, with changes in partial discharge activity providing early warnings of impending failure; partial discharges have been detected at multiple locations within the switchboard, including the compound-filled cables terminations and cable boxes, circuit breaker spouts and the B-C bus tie area that includes the compound-filled busbars;
- compound-filled switchboards are not designed to contain arc-faults, creating the potential for adverse safety outcomes associated with explosive failures;
- the configuration and loading of LQ are such that a fault would be expected to negatively impact on CitiPower’s ability to supply load to the CBD; and
- good asset management practice from the broader industry supports the view that compound-filled and non-arc fault contained switchboards pose an increasing safety and reliability risk, and should be progressively removed from service.

The identified need at LQ is to:

i. protect power sector workers and members of the public from harm caused by equipment failure (Safety); and

ii. continue to maintain a reliable power supply to the residences and businesses that are dependent on the supply from this distribution network (Reliability).

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[1] https://www.aer.gov.au/system/files/CitiPower%20-%20Regulatory%20Proposal%20-%2031%20January%202020.pdf

Solutions to the identified need shall manage and mitigate the increasing risk of secondary asset and switchgear failure, to maintain safety and reliability of electricity supply to CitiPower's customers and workforce within the LQ supply area. Solutions need to support CitiPower plans to reduce the population of non-arc fault contained switchboards that comprise oil filled circuit breakers and electromechanical protection and control relays.

Table 1 summarises the forecast financial impact of the identified need on reliability and safety for customers within the LQ supply area, expressed as the Expected Unserved Energy (EUE) cost and the safety risk cost respectively.

Table 1: Forecast Impact of the Identified Need – Safety and Reliability ($'000, Real 2024)

Financial Year	EUE Cost	Safety Risk Cost[2]	Total Risk Cost
2024	691	1173	1864
2025	806	1183	1989
2026	846	1194	2041
2027	875	1207	2082
2028	901	1222	2124
2029	935	1240	2174
2030	978	1260	2238
2031	1034	1284	2319
2032	1105	1313	2419
2033	1138	1333	2471
2034	1162	1355	2517
2035	1187	1378	2565
2036	1214	1404	2618
2037	1244	1434	2678
2038 - 2050	1244 p.a.	1434 p.a.	2678 p.a.

For the purposes of this RIT-D, economic evaluations are undertaken over a 25-year analysis period.

Table 2 provides a summary of the base case option, using the risk costs presented in Table 1.

Table 2: Base Case

Option	Description
Do nothing (status quo)	This base case option involves running the LQ secondary systems and 11 kV switchboard to failure. That is, continue with existing maintenance of this equipment, coupled with replacement upon failure. This option does not address the identified need as it does not address the growing network reliability and safety risks. The present value of all costs (EUE and safety risk) is $38.94 million (Real, 2024).

2 For simplicity, no AFAP disproportionate factors have been applied to the Safety Risk Cost.

1.7 Credible Options for Addressing the Identified Need

Table 3 provides a summary of credible options that could address the identified need.

Table 3: Credible Options Under Consideration

Option	Description
1 - Replace existing LQ switchboard and secondary systems in the same building	This option replaces the entire 11 kV switchboard and secondary systems within the existing substation building. The total capital cost of this option is $28.96 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $31.56 million (Real, 2024).
2 - Establish a new switchboard and secondary systems at Gallagher Place switching station	This option installs a new 11 kV switchboard and secondary systems in a nearby switching station, allowing the existing LQ switchboard and secondary systems to be decommissioned. The total capital cost of this option is $34.24 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $36.38 million (Real, 2024).

The purpose of the RIT-D is to identify the preferred option, being the credible option that maximises the present value of net market benefit to all those who produce, consume and transport electricity in the National Electricity Market (NEM). In order to quantify the net market benefits of each credible option, the value of EUE and safety risk cost under the base case (where no action is taken by CitiPower) is compared against the value of EUE and safety risk cost with each of the credible options in place.

1.8 Scenarios and Sensitivities Considered

In order to test the robustness of the RIT-D preferred option to changes in assumptions, a set of sensitivities to key input variables of the analysis has been applied. Table 4 lists the variables and respective ranges adopted for the purpose of defining sensitivities.

Table 4: Sensitivity Analysis Variables

Sensitivity Testing	Lower Bound	Base Value	Upper Bound
Maximum demand	90%	100%	105%
Capital and operational costs	80%	100%	120%
Value of customer reliability	80%	100%	120%
Discount rate	2.22%	4.43%	6.65%
Asset failure rates	85%	100%	115%

The NER stipulates that the RIT-D must be based on a cost-benefit analysis that considers a number of reasonable scenarios of future supply and demand[3]. For the identified need in this RIT-D assessment, the major input variables that impact future reliability and safety outcomes within the LQ supply area, are changes in the demand for electricity and changes in the asset failure rates. The scenarios and their weightings that are used in the economic evaluation to identify the preferred option, are summarised in Table 5.

[3] NER: clause 5.17.1(c) paragraph 1

Table 5: Scenario Variables and Weightings

Scenario Definition	Low Scenario	Central Scenario	High Scenario
Weighting	25%	50%	25%
Maximum demand	90%	100%	105%
Asset failure rate	85%	100%	115%

Four scenarios are considered:

- Central scenario (Maximum demand and Asset failure rate set to the base values in Table 4)
- Low scenario (Maximum demand and Asset failure rate set to the lower bound values in Table 4)
- High scenario (Maximum demand and Asset failure rate set to the upper bound values in Table 4)
- Weighted scenario (Comprising 25% worth of low scenario; 50% worth of central scenario; and 25% of high scenario).

1.9 NPV Results

Table 6 sets out a comparison of the present value of net market benefits of each option under all reasonable scenarios, over a 25-year period.

Table 6: Present Value of Net Market Benefits of Credible Options - Scenarios ($'000, Real 2024)

Scenario	Do Nothing		Option 1		Option 2	
	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking
Weighted	0	3	7,274	1	2,460	2
Central	0	3	7,378	1	2,564	2
Low	0	2	1,095	1	(3,718)	3
High	0	3	13,244	1	8,431	2

The RIT-D assessment summarised in Table 6 demonstrates that Option 1 maximises the present value of net market benefits under the Weighted Scenario (i.e. a weighting of the Central, Low and High Scenarios).

For all reasonable scenarios considered, Option 1 maximises the present value of net market benefits for all scenarios.

Based on the Weighted Scenario, the preferred option for investment in the LQ supply area is therefore Option 1 (i.e. Replace existing LQ switchboard and secondary systems in the same building). Option 1 satisfies the requirements of the RIT-D.

The robustness of the preferred option to credible changes in input variables is summarised in the sensitivity analysis results of Table 7.

Table 7: Present Net Market Benefits of Credible Options - Sensitivities ($'000, Real 2024)

Sensitivity for Central Scenario	Option 1	Option 2
All Variables: Base values	7,378	2,564
Maximum demand: Lower bound	5,836	1,049
Maximum demand: Upper bound	8,135	3,322
Capital and operational costs: Lower bound	12,649	8,799
Capital and operational costs: Upper bound	2,106	(3,670)
Value of customer reliability: Lower bound	4,347	(466)
Value of customer reliability: Upper bound	10,408	5,595

Sensitivity for Central Scenario	Option 1	Option 2
Discount rate: Lower bound	17,414	12,373
Discount rate: Upper bound	745	(3,659)
Asset failure rates: Lower bound	2,383	(2,430)
Asset failure rates: Upper bound	12,373	7,559

Option 1 has a present value of net market benefit that remains positive under all credible sensitivities, and when compared with Option 2, clearly maintains its status as the preferred option.

Although the choice of the preferred option is clear, the optimum timing of this investment is not, given a number of reasonable scenarios are investigated. The economic timing of the preferred option is when the annualised value of EUE and safety risk cost (i.e. the annualised cost of the total risk) exceeds the annualised cost of the preferred option (i.e. the annualised investment cost). annualised cost of the total risk) exceeds the annualised cost of the preferred option (i.e. the annualised investment cost). Table 8 shows the expected optimum timing of the preferred option under each reasonable scenario.

Table 8: Expected Timing of the Preferred Option

Scenario	Annualised cost of total risk minus investment costs ('000, Real 2024)				Optimum Timing Before Summer[4]
	2025	2026	2027	2028	
Weighted	701	753	795	836	2024/25
Central	705	757	799	840	2024/25
Low	243	281	312	343	2024/25
High	1151	1216	1268	1319	2024/25

While the optimum timing is identified as 2024/25, it is not practical to complete the works by this time. Therefore, considering the three-year lead time, under the Weighted Scenario the optimum timing of Option 1 is prior to summer 2027/28 (i.e. November 2027).

1.10 Preferred Option

The preferred option (Option 1) maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the NEM, considering a set of reasonable state-of-the-world scenarios and their weightings.

The preferred option involves replacing the existing LQ switchboard and secondary systems in the same substation building.

The preferred option was tested under a range of sensitivities. In each case, Option 1 was confirmed to provide positive economic benefits and is the highest-ranked option in all sensitivities.

The optimum timing for commissioning of the preferred option is no later than November 2027.

The preferred option has a capital cost of $28.96 million (Real, 2024).

The 25-year present value of net market benefits associated with the preferred option is $7.38 million (Real, 2024).

[4] The economic analysis concludes the optimum timing is 2024/25 however the preferred option cannot be constructed within this timeframe. Instead it can be constructed before the 2027/28 summer.

1.11 Next Steps

This FPAR represents the final stage of the RIT-D process.

In accordance with the provisions set out in clause 5.17.5, paragraph (c) of the NER, Registered Participants or interested parties may, within 30 days after the publication of this report, dispute the conclusions made by CitiPower in this report with the Australian Energy Regulator (AER).

Accordingly, Registered Participants and interested parties who wish to dispute the recommendation outlined in this report must do so by 1 December 2024. Any parties raising such a dispute are also required to notify to CitiPower at ritdenquiries@citipower.com.au. If no formal dispute is raised, CitiPower will commence with the investment activities necessary to proceed with the implementation of the preferred option

For the purposes of referencing this RIT-D, this RIT-D is referred to as the "*Little Queen Zone Substation Secondary Assets and Switchgear Condition*" identified need.

2. Introduction

CitiPower is a regulated Victorian electricity distribution business. It distributes electricity to around 349,000 homes and businesses in Melbourne's central business district (CBD) and inner suburbs.

The CitiPower electricity distribution network consists of more than 58,207 poles and over 7,525 kilometres of overhead lines and underground cables. Electricity is received via 70 sub-transmission lines at 33 zone substations, where it is transformed from sub-transmission voltages down to distribution voltages.

The need for investment and the possible options for addressing the Little Queen Zone Substation Secondary Assets and Switchgear Condition identified need, have been foreshadowed in CitiPower's 2023 Distribution Annual Planning Report (DAPR)[5]

This Final Project Assessment Report (FPAR) has been prepared by CitiPower in accordance with the requirements of clause 5.17.4, paragraph (r) of the National Electricity Rules (NER) version 217, and is consistent with the Australian Energy Regulator's (AER) RIT-D Application Guidelines[6] and the Industry Practice Application Note for Asset Replacement Planning[7]

The publication of this FPAR represents the final stage of the consultation process in relation to the application of the RIT-D as required under clause 5.17.4(o) of the NER, for addressing the identified need, associated with the network safety and reliability risks within the LQ supply area. It sets out the matters detailed in the DPAR, and summarises the submissions received on that report. The NER requires that the FPAR includes matters detailed in NER clause 5.17.4, paragraph (r)(1), summarised as follows:

- Provide background information on the network servicing the LQ supply area and its limitations;
- Describe the need which CitiPower is seeking to address, together with the assumptions used in identifying that need;
- Describe the credible options that are considered in this RIT-D assessment;
- Explain the materiality of each class of market benefit;
- Describe the methods used in quantifying each material market benefit;
- Quantify costs, high-level cost breakdowns, and material market benefits for each of the credible options;
- Present the results of a Net Present Value (NPV) analysis, with explanatory statements regarding the results;
- Identify the preferred option, its costs, optimum timing and its technical characteristics; and
- A summary of any submissions received on the DPAR and the responses to those submissions.

[5] CitiPower: Distribution Annual Planning Report. Available at: https://dapr.powercor.com.au/powercor_data/DAPR_2023_Citipower_Distribution%20Annual%20Planning%20Report.pdf

[6] AER: "AER – RIT-D Application Guidelines – October 2023". Available at: https://www.aer.gov.au/system/files/2023-10/AER%20-%20RIT-D%20guidelines%20-%20final%20amendments%20%28marked%20up%29%20-%206%20October%202023_0.pdf

[7] AER: "AER – Industry Practice Application Note – Asset Replacement Planning – January 2019". Available at: https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf

3. Definitions

Table 9: Terms and Definitions

Term	Definition
A.C.	Alternating Current
AEMO	Australian Energy Market Operator
AFAP	As Far As Practicable
DAPR	Distribution Annual Planning Report
D.C.	Direct Current
DPAR	Draft Project Assessment Report
DSED	Demand Side Engagement Document
EUE	Expected Unserved Energy (MWh pa)
FPAR	Final Project Assessment Report
LQ	Little Queen Zone Substation
JA	Little Bourke Street Substation
MWp	Megawatt peak
NCC	Network Control Centre
NEM	National Electricity Market
NER	National Electricity Rules
O&M	Operations and Maintenance
PD	Partial Discharge
PoE	Probability of Exceedance
RIT-D	Regulatory Investment Test for Distribution
SAPS	Standalone Power System
VCR	Value of Customer Reliability ($/MWh)
VM	Victoria Market Zone Substation
WMTS	West Melbourne Terminal Station
50% PoE	The forecast maximum demand has a 50% probability of exceedance (PoE). That is, the forecast maximum demand is expected, on average, to be exceeded once in two years.
10% PoE	The forecast maximum demand has a 10% probability of exceedance (PoE). That is, the forecast maximum demand is expected, on average, to be exceeded once in ten years.
Credible option	An option that addresses the 'identified need', is commercially and technically feasible, and can be implemented in sufficient time to meet the 'identified need'.
Identified need	Any capacity, voltage, or safety limitation on the distribution system.

Term	Definition
Limitation	Any limitations on the operation of the distribution system that will give rise to Expected Unserved Energy or safety risk consequences.
Network option	A means by which an ‘identified need’ can be fully or partly addressed by expenditure on distribution network assets.
Non-network or SAPS option	A means by which an ‘identified need’ can be fully or partially addressed other than by a network option.
Non-network service provider	A party who provides a non-network or SAPS option.
Potential credible option	An option has the potential to be a credible option based on an initial assessment of its ability to address the ‘identified need’.
Preferred network option	A credible network option that maximises the present value of net economic benefit to all those who produce, consume and transport electricity in the NEM. The preferred network option can be a network option, or do nothing (i.e. status quo).
Preferred option	A credible option that maximises the present value of net economic benefit to all those who produce, consume and transport electricity in the NEM. The preferred option can be a network option, non-network or SAPS option, combination of both, or do nothing.

4. Identified Need

4.1 Network Overview

The area of CitiPower's electricity distribution network that is the subject of this Regulatory Investment Test for Distribution (RIT-D) is the Little Queen Zone Substation (LQ) supply area (i.e. LQ supply area), which is located in the heart of Melbourne's CBD.

LQ is owned and operated by CitiPower, providing power to approximately 5,384 customers, with the majority of the load at LQ comprising of high-rise commercial and residential customers.

LQ is supplied by three sub-transmission circuits originating from the West Melbourne Terminal Station (WMTS) via Victoria Market (VM) and Little Bourke Street (JA) zone substations. This zone substation supplies part of the central Melbourne CBD and comprises three 60 MVA transformers operating at 66/11 kV, connected to three double busbar 11 kV buses in a compound insulated metal clad switchboard with 41 11 kV distribution feeders.

The cyclic rating of LQ with all transformers in service is 180 MVA, and with one transformer out of service the rating reduces to 132 MVA in summer, and 142 MVA in winter. This compares to a forecast 10% PoE maximum demand of 77.8 MVA for 2024/25, rising to 80.7 MVA by 2027/28. The switchboard configuration diagram for LQ, is illustrated in Figure 1.

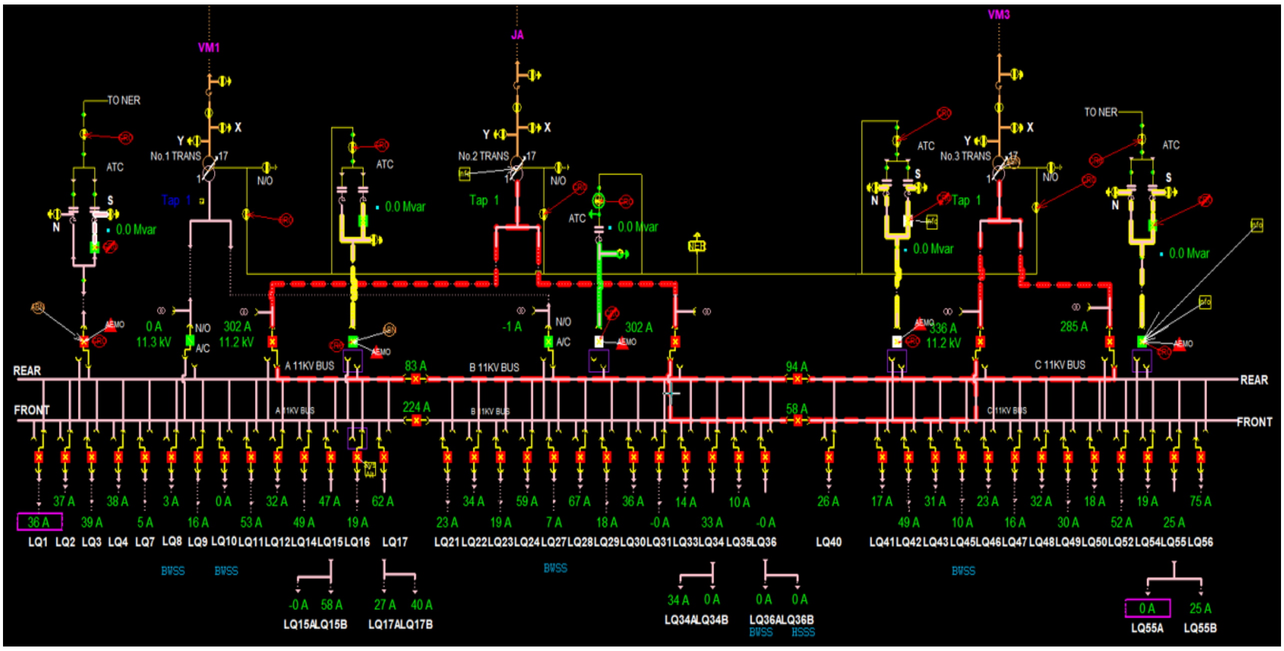

Figure 1: LQ Electrical Single Line Diagram

The power supply coverage of LQ is illustrated in Figure 2. The supply area is bounded approximately by Elizabeth St in the east, Lonsdale St in the north, Collins St in the south, and Spencer St in the west.

Figure 2: LQ Supply Area

4.2 Description of the Identified Need

LQ was constructed in the early 1970s and most of the original substation equipment remains in service. This includes the existing compound-insulated double bus switchboard and bulk oil-filled switchgear which was designed with no arc fault containment, presenting a safety risk to our operators and personnel accessing this site. The switchboard and secondary systems at LQ are deteriorating in condition and are at end of life.

The condition of the secondary assets[8] and switchgear[9] at LQ, necessary for the provision of a safe and reliable power supply to customers within the LQ supply area, are deteriorating, and technically obsolete, being unsupported by equipment suppliers with no spares.

The LQ 11 kV switchboard is non-arc fault contained and consists of three compound insulated double bus sections with fifty-six panels containing mainly J18 and J22 bulk oil circuit breakers with five retrofitted Siemens 3AH vacuum circuit breakers installed in 2005 for the capacitor banks.

The insulation of the LQ 11 kV switchboard has been deteriorating over the last several years with an online partial discharge (PD) monitor system installed in November 2017. A number of minor PD sources have been identified and rectified however these repairs are not a long-term solution as other PD sources detected from within the bus by the online monitoring system indicate that imminent replacement is warranted. These other PD sources are not possible or feasible to repair and are therefore terminal to the switchboard.

Switchgear and cables condition monitoring show that increasing PD in both compound and solid insulation is a problem and has been on steady increase with two to three new locations across the entire switchboard per year for the last five years. For every repair that is undertaken by CitiPower, two new PD locations commence. Four new PD locations have been detected in the last four months (April-July 2024) indicating the deterioration rate is accelerating. Active PD sources

[8] protection, control, monitoring, D.C. supplies and communications equipment.

[9] circuit breakers and associated switchboard.

now impact more than 47% of the switchboard panels - evenly distributed across all busses. Failure of this equipment would likely be catastrophic, resulting in explosion and fire and extended interruption to electricity supply.

Protection and control systems are critical to the safe and reliable operation of the network. These systems are designed to detect the presence of power system faults and/or other abnormal operating conditions, and to automatically isolate the faulted network by the opening of appropriate high-voltage circuit breakers. Failure to isolate power system faults will invariably result in severe damage to network assets, presenting a serious health and safety hazard to the public, and greatly increases the risk of fire-starts. The original secondary assets at LQ including electromechanical protection relays are also experiencing condition deterioration, and are technically obsolete with limited spares, and no longer supported by vendors. All of these factors increase the likelihood of a power system fault not being detected and safely isolated, or a maloperation. This poses a serious safety and reliability risk for the ongoing fault protection coverage of LQ and its distribution network. For any faults not effectively cleared by the local LQ protection, this will back up to upstream supply protection devices increasing the amount of load impacted and the number of customers with supply at risk, impacting areas of the CBD greater than just the LQ supply area.

The asset management need at LQ is to maintain a safe and reliable supply of electricity to customers in the LQ supply area. This recognises the risks associated with the existing switchboard, including the increasing probability, severity, and consequence of failure—for example[10]:

- deterioration in compound-filled assets is typically monitored by measuring partial discharge activity, with changes in partial discharge activity providing early warnings of impending failure; partial discharges have been detected at multiple locations within the switchboard, including the compound-filled cable terminations and cable boxes, circuit breaker spouts and the B-C bus tie area that includes the compound-filled busbars;
- compound-filled switchboards are not designed to contain arc-faults, creating the potential for adverse safety outcomes associated with explosive failures;
- the configuration and loading of LQ are such that a fault would be expected to negatively impact on CitiPower's ability to supply load to the CBD;
- good asset management practice from the broader industry supports the view that compound-filled and non-arc fault contained switchboards pose an increasing safety and reliability risk, and should be progressively removed from service.

The identified need at LQ is to:

i. protect power sector workers and members of the public from harm caused by equipment failure (Safety); and
ii. continue to maintain a reliable power supply to the residences and businesses that are dependent on the supply from this distribution network (Reliability).

Solutions to the identified need shall manage and mitigate the increasing risk of secondary asset and switchgear failure, to maintain safety and reliability of electricity supply to CitiPower's customers and workforce within the LQ supply area. Solutions need to support CitiPower plans to reduce the population of non-arc fault contained switchboards that comprise oil filled circuit breakers and electromechanical protection and control relays.

4.3 Quantification for the Identified Need

Table 10 summarises the forecast impact of the identified network need discussed in Section 4.2 on customers. The table shows over a 15-year forecasting period, the risk costs and hence the potential market benefits considered, including:

- Expected unserved energy (EUE) cost, which is the value of the energy at risk after taking into account the probability of asset failures or malfunctions at LQ, representing the deterioration in supply reliability within the LQ supply area.
- Safety risk cost, which is the cost of harm to CitiPower's staff and the general public located within the LQ supply area, as a result of anticipated safety incidents caused by asset failures or malfunctions at LQ.
- Total risk which is the sum of the EUE cost and the safety risk cost.

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[10] Regulatory proposal 2021–2026, January 2020, CitiPower. https://www.aer.gov.au/system/files/CitiPower%20-%20Regulatory%20Proposal%20-%2031%20January%202020.pdf.

Table 10: LQ Reliability and Safety Risk Quantification ($'000, Real 2024)

Financial Year	Expected Unserved Energy Cost	Safety Risk Cost[11]	Total Risk Cost
2024	691	1173	1864
2025	806	1183	1989
2026	846	1194	2041
2027	875	1207	2082
2028	901	1222	2124
2029	935	1240	2174
2030	978	1260	2238
2031	1034	1284	2319
2032	1105	1313	2419
2033	1138	1333	2471
2034	1162	1355	2517
2035	1187	1378	2565
2036	1214	1404	2618
2037	1244	1434	2678
2038 - 2050	1244 p.a.	1434 p.a.	2678 p.a.

For the purposes of this RIT-D, economic evaluations are undertaken over a 25-year period. Table 11 provides a summary of the base case option, using the risk costs presented in Table 10.

Table 11: Base Case

Option	Description
Do Nothing (status quo)	This base case option involves running the LQ secondary systems and 11 kV switchboard to failure. That is, continue with existing maintenance of this equipment, coupled with replacement upon failure. This option does not address the identified need as it does not address the growing network reliability and safety risks. The present value of all costs (EUE and safety risk) is $38.94 million (Real, 2024).

[11] For simplicity, no AFAP disproportionate factors have been applied to the Safety Risk Cost.

5. Key Assumptions in Relation to the Identified Need

5.1 Method of Quantifying the Identified Need

CitiPower adopts its Asset Risk Quantification Guide in quantifying safety and reliability risks associated with asset condition failures and their consequences. CitiPower calculates the impact of changes in safety and reliability (in the form of involuntary load shedding), by comparing the total value of the safety cost and value of EUE under the base case (where no action is undertaken by CitiPower) with each of the credible options in place using the assumptions below.

5.1.1 Safety

The safety risk to CitiPower employees and the general public, arising from potential failure or malfunction of network assets is quantified by CitiPower using an annualised safety risk cost, based on the asset conditions. The safety risk cost provides a measure of the expected financial value of the safety risk event. The safety risk cost is defined as the probability weighted cost of consequences, with the likelihood of consequences being the moderating factor in quantifying the risk.

The Electricity Safety Act[12] requires CitiPower to design, construct, operate, maintain, and decommission its network to minimise hazards and risks to the safety of any person as far as reasonably practicable, or until the costs become disproportionate to the benefits from managing those risks. As such, CitiPower's approach to safety risk is based on the As Far As Practicable (AFAP) principle.

In implementing this principle for assessing safety risks from asset condition failures, CitiPower uses a Value of Statistical Life (VSL) to estimate the benefits of reducing the risk of death, a value of Lost Time Injury (LTI) to estimate the benefits of reducing the risk of injury, and a disproportionality factor[13] CitiPower notes that this approach, including the use of a disproportionality factor , is consistent with practice notes provided by the AER[14], and is the approach taken by other network service providers within the NEM.

The AFAP principle recommends safety risk reduction measures be implemented unless the cost, time or form of the risk reduction measure is grossly disproportionate to the benefit gained from the reduced risk. A "Do Nothing" (or run to failure) approach would result in the poor condition assets remaining in service, deteriorating further, and completely failing to address any safety concerns.

5.1.2 Reliability

CitiPower's reliability planning standard for its zone substation assets is based on a probabilistic planning approach which quantifies annualised EUE (in MWh per annum) of energy not supplied, taking into account the network capacity, demand characteristics, unavailability of an asset due to a failure (or malfunction), and the restoration time. The value of EUE is expressed financially by multiplying the EUE with a locational Value of Customer Reliability (VCR) ($/MWh).

As required under the clause 19.5 of the Victorian Electricity Distribution Code of Practice[15], a more conservative (N-1) secure planning approach is applied for the Melbourne CBD electricity network.

5.2 Forecast Maximum Demand

LQ is located in the heart of Melbourne's CBD. It supplies electricity to over 5,384 customers being mainly high-rise commercial and residential customers.

Forecasts of the 10% PoE and 50% PoE summer maximum demand and power factor at LQ are presented in Table 12. These forecasts are based on an expected economic growth scenario.

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[12] Victorian State Government, Victorian Legislation and Parliamentary Documents, Electricity Safety Act 1998. Available at: https://www.legislation.vic.gov.au/in-force/acts/electricity-safety-act-1998/081.

[13] For simplicity, no AFAP disproportionate factors have been applied to the Safety Risk Cost.

[14] AER: "AER – Industry Practice Application Note – Asset Replacement Planning – January 2019". Available at: https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf.

[15] ESC: Electricity Distribution Code of Practice (clause 19.5, version 2, 1st May 2023), https://www.esc.vic.gov.au/electricity-and-gas/codes-guidelines-and-policies/electricity-distribution-code-practice.

Table 12: LQ Maximum Demand Forecast

Financial Year Ending	Power factor	10% PoE (MVA)	50% PoE (MVA)
2025	0.96	77.8	74.1
2026	0.96	80.0	76.2
2027	0.96	80.7	76.8
2028	0.96	80.7	76.8
2029	0.96	80.8	76.8

5.3 Forecast Annual Energy

Forecasts of the net annual energy requirements of customers within the LQ supply area as shown in Table 13.

Table 13: LQ Annual Energy

Financial Year Ending	Energy (GWh pa)
2025	267
2026	274
2027	276
2028	276
2029	277

5.4 Characteristic of Load Profile

CitiPower has prepared load profiles that are characterised by the use of profiles from the most recent 50% PoE year. Based on this approach, the 2022/23 historical demand profile has been prepared and presented herein.

The coincident maximum demand of the customers within the LQ supply area occurs during days of extreme ambient temperature. The annual demand profile at LQ expressed as a percentage of the 50% PoE maximum demand listed in Table 12, is illustrated in Figure 3.

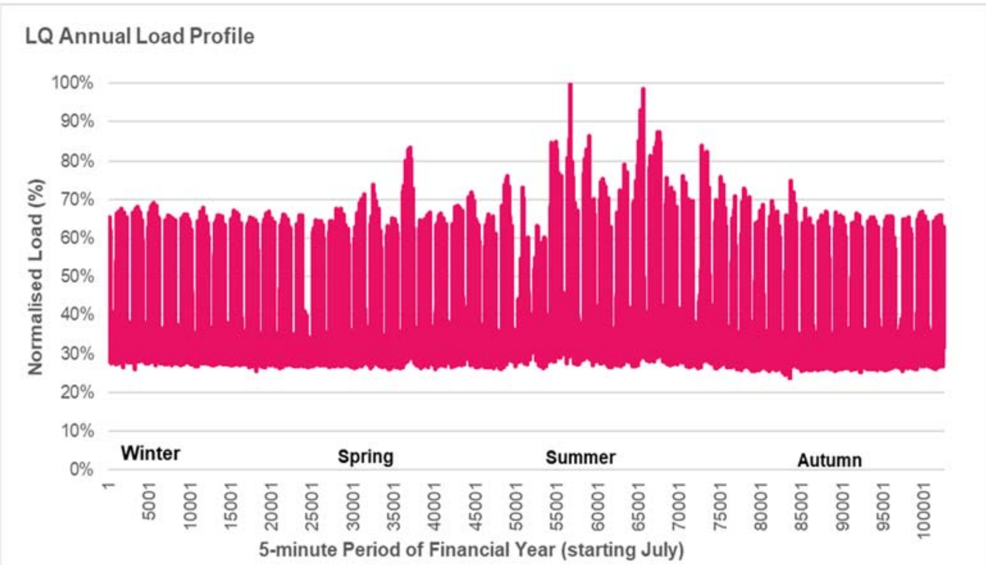

Figure 3: Annual Load Profile at LQ

The load profile on the day of a 50% PoE summer maximum demand is illustrated in the load profile on the day of a 50% PoE summer maximum demand is illustrated in Figure 4. The prominence of commercial load and low levels of solar PV penetration within the LQ supply area, results in a maximum demand occurring during business hours in the afternoon.

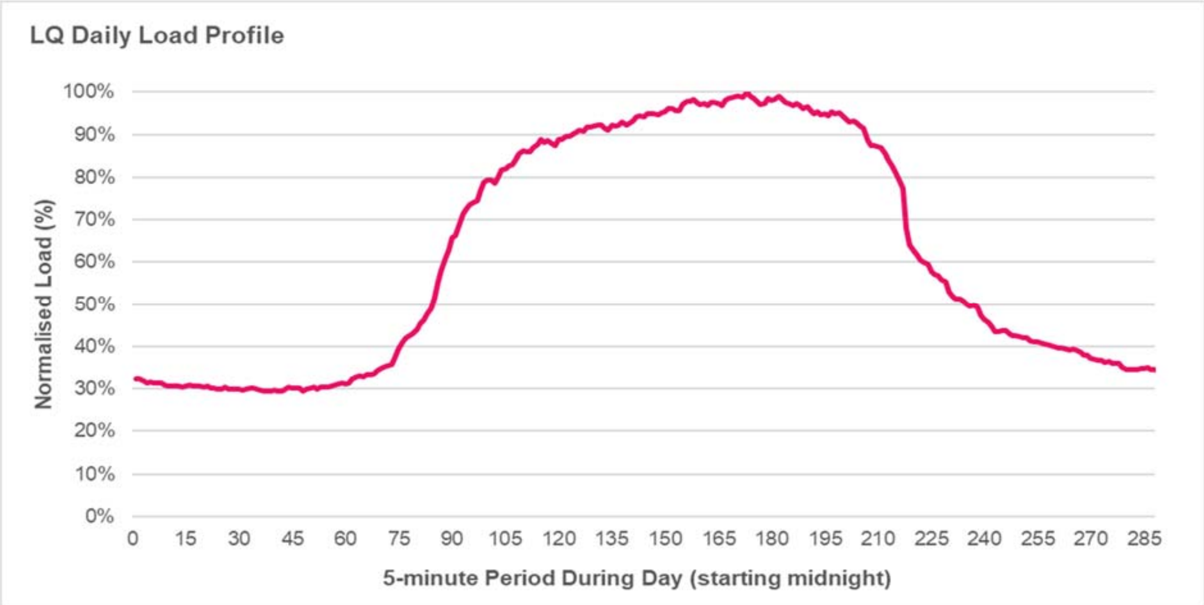

Figure 4: Load Profile on Day of Summer Maximum Demand at LQ

Figure 5 shows the normalised LQ annual load-duration curve for a 50% PoE summer maximum demand year.

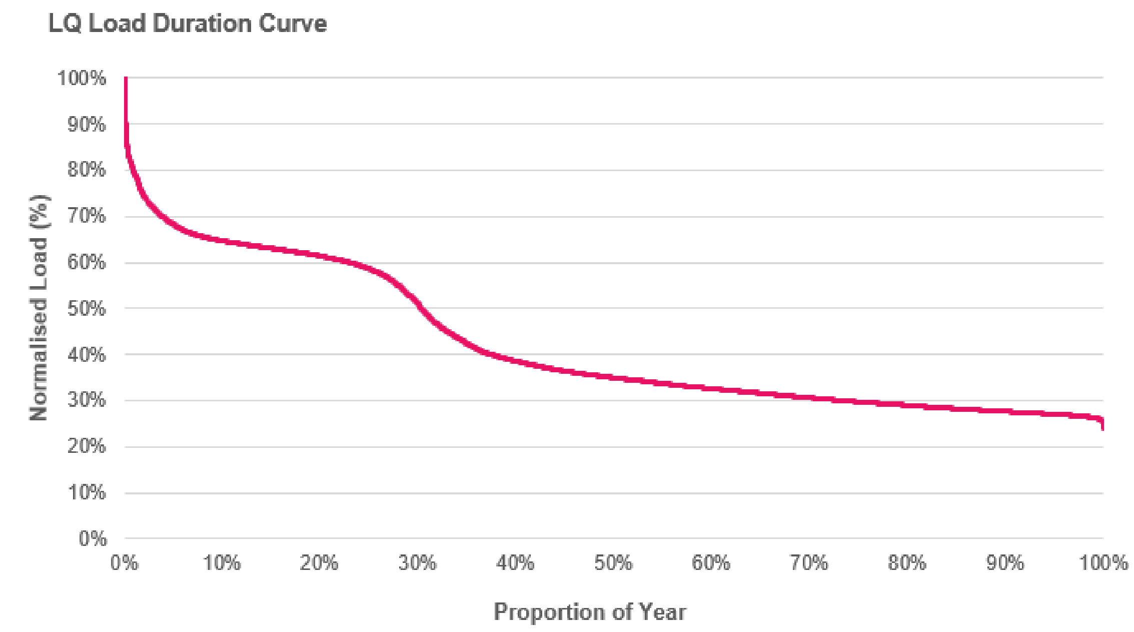

Figure 5: Annual Load Duration Curve at LQ

The load characteristics can vary marginally from year to year due to changes in weather, and underlying changes in the customers' load usage. Figure 5 shows that load in excess of 80% of the maximum demand lasts for less than 2% of the year. It also shows that LQ has a higher penetration of air conditioning cooling which operates for a very small fraction of the year.

5.5 Load Transfer Capacity and Supply Restoration Times

The load transfer capability between LQ and the neighbouring networks of JA and FR zone substations (among others) is 17.5 MVA for summer 2024/25.

Future load transfer capability levels between LQ and the neighbouring network is assumed to remain relatively constant.

Customers' supply is normally restored within 30 minutes (on average) following the loss of a major plant item (i.e. a zone substation transformer, or distribution feeder) causing an outage.

5.6 Discount rates

To compare cash flows of options with different time profiles, it is necessary to use a discount rate to express future costs and benefits in present value terms. The choice of discount rate will impact on the estimated present value of net market benefits and may affect the ranking of alternative options. A discount rate of 4.43 per cent is used.

5.7 Asset Ratings

The existing capabilities of LQ zone substation for summer and winter are presented in Table 14 for all transformers in service (N), and for one transformer out of service (N-1).

Table 14: Summary of LQ Ratings (MVA)

Power Flow Condition	Summer Cyclic Rating at 40°C		Winter Cyclic Rating at 10°C	
	N	**N-1**	**N**	**N-1**
Import[16]	180.0	132.0	180.0	142.0
Export[17]	-180.0	-120.0	-180.0	-120.0

5.8 Value of Customer Reliability

Location-specific Value of Customer Reliability (VCR) is used to value reliability of supply. The locational VCR for the LQ supply area was derived from the sector VCR estimates provided by the AER, weighted in accordance with the composition of the load, by sector, and escalated by CPI. This is summarised in Table 15.

Table 15: Summary of Location Specific VCR

Zone Substation	VCR ($ per MWh, Real 2024)
LQ	54,123

5.9 Asset Failure Rates

The base (average) reliability and safety consequence data adopted in this assessment is presented in Table 16, Table 17 and Table 18 below. The data is based on observed CitiPower asset failure rates.

Table 16: Summary of Asset Failure Rates and Hazard Function (Weibull Distribution Parameters)

Equipment		α parameter	β parameter
Electro-mechanical Relay (Failure to Operate)		6.0	75
Analogue Relay (Failure to Operate)		4.0	56

16 Power flow towards customer load.

17 Power flow towards the transmission network.

Equipment		α parameter	β parameter
Digital / Numerical Relay (Failure to Operate)		3.0	36
Switchgear (Failure)		6.8	69

Table 17: Summary of Asset Reliability Consequence Probability

Equipment	Consequence	Probability
Electro-mechanical Relay (Reliability)	Bus Outage Feeder Outage	37% 16%
Analogue Relay (Reliability)	Bus Outage Feeder Outage	32% 16%
Digital / Numerical Relay (Reliability)	Bus Outage Feeder Outage	21% 9%

Table 18: Summary of Asset Safety Consequence Probability

Equipment	Consequence	Probability
All Protection Relays (Safety)	Injury Death – Public Death – Staff	0.0260% 0.0115% 0.1960%

5.10 Value of Safety Consequence

Values of safety consequence used in this RIT-D are derived from various sources including Safe Work Australia[18] for LTI, and the Department of Prime Minister and Cabinet, Best Practice Regulation Guidance Note[19] for VSL, (adjusted to Real 2024). These values of safety consequence are summarised in Table 19.

Table 19: Summary of Safety Consequence Values

Safety Consequence	Value of Safety Consequence ($'000, Real 2024)
Injury (LTI)	151
Death (VSL)	5,362

6. Credible Options

CitiPower presented eight options (network, non-network and standalone power system) in the Notice of Determination report published on 19 September 2024. Only two network options were regarded as being credible for the reasons set

[18] Safe Work Australia, The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13. Available at: https://www.safeworkaustralia.gov.au/system/files/documents/1702/cost-of-work-related-injury-and-disease-2012-13.docx.pdf.

[19] Department of the Prime Minister and Cabinet, Australian Government, Best Practice Regulation Guidance Note: Value of statistical life. Available at: https://oia.pmc.gov.au/resources/guidance-assessing-impacts/value-statistical-life.

out in that report and assessed in the DPAR. Details of the credible options that are assessed in this RIT-D against the base case are presented in Table 20.

Table 20: Credible Options Under Consideration

Option	Description
1 - Replace existing LQ switchboard and secondary systems in the same building	This option replaces the entire 11 kV switchboard and secondary systems within the existing substation building. The total capital cost of this option is $28.96 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $31.56 million (Real, 2024).
2 - Establish a new switchboard and secondary systems at Gallagher Place switching station	This option installs a new 11 kV switchboard and secondary systems in a nearby switching station, allowing the existing LQ switchboard and secondary systems to be decommissioned. The total capital cost of this option is $34.24 million (Real, 2024). The present value of all costs (capital, O&M, EUE and safety risk) is $36.38 million (Real, 2024).

The purpose of the RIT-D is to identify the preferred option, being the credible option that maximises the present value of net market benefit to all those who produce, consume and transport electricity in the National Electricity Market (NEM). In order to quantify the net market benefits of each credible option, the value of EUE and safety risk cost under the base case (where no action is taken by CitiPower) is compared against the value of EUE and safety risk cost with each of the credible options in place.

7. Submissions to the DPAR

This section summarises the consultation to date and the submissions received on the DPAR.

A RIT-D Stage 1 Notice of Determination, published on CitiPower's website on 19 September 2024, was prepared to present the potential options being considered and establish whether the proposed network solution to address the need, could be changed in scope or otherwise altered in response to a non-network or SAPS solution.

It was concluded that there would unlikely be any potential credible non-network or SAPS options (or any combination of those options, or with a network option) that could adequately and economically address the identified need within the LQ supply area.

A RIT-D Stage 2 Draft Project Assessment Report, published on CitiPower's website on 19 September 2024, was prepared for consultation and presented the economic evaluation of the credible options and identified the proposed preferred option.

Option 1 was identified as the proposed preferred option, comprising of replacing the existing LQ switchboard and secondary systems in the same building.

There were no submissions received by CitiPower on the DPAR during the consultation period.

8. Market Modelling Methodology

The RIT-D requires market benefits identified to be material, to be calculated by comparing the state-of-the-world in the base case (where no action is undertaken by CitiPower), against each of the credible options in place. The states-of-the-world are a range of reasonable and mutually consistent scenarios of credible supply and demand characteristics and conditions that may affect the calculation of the market benefits over the period of assessment. The selection of the preferred option is informed by a weighting of all the reasonable scenarios.

The RIT-D economic analysis has been undertaken over a 25-year period, commensurate with the long-lived nature of the investments considered in this RIT-D assessment. For simplicity, the risk modelling for calculation of market benefits is calculated across a forecast horizon up to 2037. The market benefits calculated in 2037 has been applied as the assumed annual market benefit that would continue to arise until the end of the 25-year period.

Furthermore, a set of sensitivity studies is undertaken on the preferred option by varying key input variables, to test the economic viability and rank of the preferred option against other options and the base case, for all credible changes in assumptions.

8.1 Classes of market benefits considered material

The purpose of the RIT-D is to identify the credible option that maximises the present value of net market benefits to all those who produce, consume and transport electricity in the National Electricity Market (NEM).

In order to measure the increase in net market benefit, CitiPower has analysed the classes of market benefits required to be considered by the RIT-D[20]. The classes of market benefits that are considered material and have been quantified in this RIT-D assessment are:

- Changes in safety risk costs [21]; and
- Changes in involuntary load shedding.

8.1.1 Changes in Safety Risk Cost

Reducing the likelihood of asset failure by addressing poor condition assets provides a better safety outcome for the supply area, by reducing potential safety incidents and the consequential risk of harm to CitiPower's personnel and the wider community. At LQ, the safety risk cost is considered to be material. The method used by CitiPower in quantifying changes in safety risk cost is described in Section 5.1.1.

8.1.2 Changes in Involuntary Load Shedding

Reducing the likelihood of asset failure by addressing poor condition assets provides a greater reliability for the supply area, by reducing potential supply interruptions and the consequential risk of involuntary load shedding. At LQ, the reliability risk cost (expressed as the value of EUE) is considered to be material. The method used by CitiPower in quantifying changes in involuntary load shedding is described in Section 5.1.2.

8.2 Classes of Market Benefits Not Expected to be Material

CitiPower considers that the following classes of market benefit are not likely to be material for this RIT-D assessment:

- Changes in load transfer capacity and the capacity of embedded generating units to take up load;
- Changes in electrical energy losses;
- Changes in voluntary load curtailment;
- Changes in costs to other parties;
- Difference in timing of expenditure; and
- Additional option value.

8.2.1 Changes in load transfer capacity and the capacity of embedded generating units

The modelling undertaken in Section 7.1.2 considers load transfer that may be expected to occur with each of the credible options in place. Changes in load transfer capability is not expected to be materially different between any of the to take up load is not expected to be materially different between any of the credible options considered, or with the base case. Credible options considered, or with the base case. Furthermore, changes in the capacity of embedded generating units to take up load is not expected to be materially different between any of the credible options considered, or with the base case.

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[20] NER: clause 5.17.1(c) paragraph 4.

[21] CitiPower notes that use of a safety risk cost as a class of market benefit is consistent with practice notes provided by the AER, and is the approach taken by other network service providers within the NEM. Refer to: "AER – Industry Practice Application Note – Asset Replacement Planning – January 2019". Available at: https://www.aer.gov.au/system/files/D19-2978%20-%20AER%20-Industry%20practice%20application%20note%20Asset%20replacement%20planning%20-%2025%20January%202019.pdf

8.2.2 Changes in electrical energy losses

The differences in electrical energy losses between credible options and with the base case is considered to be negligible.

8.2.3 Changes in voluntary load curtailment

Voluntary load curtailment is where customers agree to voluntarily curtail their electricity under certain circumstances, such as during a network asset outage event. The customer will typically receive an agreed payment for making load available for curtailment, and for actually having it curtailed during a network event. A credible demand-side reduction option leads to a change in the amount of voluntary load curtailment.

In its Notice of Determination report, CitiPower assessed the potential for voluntary load curtailment within the LQ supply area. It was identified from that report that the potential for voluntary load curtailment was immaterial to address the identified need. Therefore, this market benefit is not quantified for this RIT-D, as it was considered to be not material to differentiate between credible options, or with the base case.

8.2.4 Changes in costs to other parties

There are no material market benefits (or costs) associated with changes in costs to other parties in this instance.

8.2.5 Difference in timing of expenditure

CitiPower has determined that the timing of other unrelated expenditure is not impacted by the options considered in this assessment. Therefore, this market benefit is not quantified, as it was not considered to be relevant to differentiate between options that address the need within the LQ supply area.

8.2.6 Additional Option Value

Additional option value is likely to arise where there is uncertainty regarding future outcomes, the information that is available in the future is likely to change, and if the credible options considered by CitiPower are sufficiently flexible to respond to that change.

In the context of the LQ supply area, it is noted that a key identified need relates to safety. As there is virtually no uncertainty in the condition of the assets further deteriorating over time, and that the current condition of the assets is not tenable under the AFAP principle, there is little value in retaining flexibility.

CitiPower considers that the estimation of any option value benefits captured via the scenario analysis and comparison of the credible option under those scenarios would be adequate to meet the NER requirements to consider option value as a class of market benefit.

CitiPower therefore does not propose to estimate any additional option value market benefit for this RIT-D assessment.

8.3 Costs of Credible Options

CitiPower has estimated the capital costs of the credible options, based on actual costs from previous projects of a similar nature. They have been developed in-house by project estimators. CitiPower estimates that the actual cost is within +/- 20 per cent of the capital cost used within this RIT-D. The capital and operating cost assumptions for each credible option considered in this RIT-D assessment are summarised in Table 21.

Table 21: Capital and Operating Costs of Credible Options ($'000, Real 2024)

Option	Capital Cost	Operational Cost (pa)
Base Case - Do Nothing	0	0
Option 1 - Replace existing LQ switchboard and secondary systems in the same building	28,957	(28)
Option 2 - Establish a new switchboard and secondary systems at Gallagher Place switching station	34,245	(28)

The 25-year present value of capital, operating and risk costs for each credible option considered in this RIT-D assessment are summarised in Table 22.

Table 22: Present Value of Costs of Credible Options ($'000, Real 2024)

Option	Capital Cost	Operational Cost	Investment Cost (Net)	Risk Cost	Total Cost
Base Case - Do Nothing	0	0	0	38,940	38,940
Option 1 - Replace existing switchboard and secondary systems in the same building	26,358	(437)	25,921	5,641	31,562
Option 2 - Establish a new switchboard and secondary systems at Gallagher Place switching station	31,171	(437)	30,734	5,641	36,375

8.4 Scenarios

Clause 5.17.1 paragraph (c)(1) of the NER requires the RIT-D to be based on a cost-benefit analysis that considers a number of reasonable state-of-the-world scenarios of future supply and demand.

The development of additional reasonable scenarios applied by CitiPower for this RIT-D involved a process of applying a credible sensitivity on key input variables around a Central Scenario, to identify a credible Low Scenario and a credible High Scenario. A weighting is then assigned to each of the three scenarios, representing the likelihood of each of these state-of-the-world scenarios materialising. The Weighted Scenario is then used to identify the preferred option, as it inherently takes into account the uncertainty associated with different future states-of-the-world.

For the identified need in this RIT-D assessment, the major input variables that impact future reliability and safety outcomes within the LQ supply area, are changes in the demand for electricity, and changes in the asset failure rates. Table 23 lists the variables and ranges adopted for the purpose of defining scenarios.

Table 23: Scenario Variables and Weightings

Scenario Definition	Low Scenario	Central Scenario	High Scenario
Weighting	25%	50%	25%
Maximum demand	90%	100%	105%
Asset failure rate	85%	100%	115%

8.5 Sensitivities

In order to test the robustness of the RIT-D preferred option to changes in assumptions, a set of sensitivities to key input variables to the analysis has been applied. Table 24 lists the variables and ranges adopted for the purpose of informing sensitivity analysis.

Table 24: Sensitivity Analysis Variables

Sensitivity Testing	Lower Bound	Base Value	Upper Bound
Maximum demand	90%	100% - Refer Section 5.2	105%
Capital and operational costs	80%	100% - Refer Section 8.3	120%
Value of customer reliability	80%	100% - Refer Section 5.8	120%
Discount rate	2.22%	4.43% - Refer Section 5.6	6.65%
Asset failure rates	85%	100% - Refer Section 5.9	115%

9. Results of Analysis

The results of the Net Present Value (NPV) cost-benefit analysis for each of the credible options considered in this RIT-D assessment, for each scenario are detailed below.

9.1 Gross Market Benefits

The gross market benefit is the sum of each of the individual categories of material market benefit, as quantified on the basis of the approach set out in Section 7.1, expressed in present value terms over the 25-year analysis period.

Table 25 and Table 26 summarises the present value of gross market benefits of Option 1 and Option 2 respectively.

Table 25: Gross Market Benefits Option 1 - Replace existing switchboard and secondary systems in the same building

Option 1 Scenario	Present Value ('000, Real 2024)		
	Avoided EUE Risk	Avoided Safety Risk	Gross Market Benefit
Weighted	15,048	18,147	33,194
Central	15,152	18,147	33,299
Low	11,591	15,425	27,016
High	18,296	20,869	39,165

Table 26: Gross Market Benefits Option 2 - Establish a new switchboard and secondary systems at Gallagher Place switching station

Option 2 Scenario	Present Value ('000, Real 2024)		
	Avoided EUE Risk	Avoided Safety Risk	Gross Market Benefit
Weighted	15,048	18,147	33,194
Central	15,152	18,147	33,299
Low	11,591	15,425	27,016
High	18,296	20,869	39,165

The gross market benefits of Option 1 and Option 2, are identical, hence the option with the lowest present value of investment cost will pass the RIT-D. Refer 9.4 for more information on the optimum timing of each option.

Figure 6 shows the breakdown of gross market benefits for Option 1 and Option 2 for each year up to 2040 under the Central Scenario, assuming an implementation completion date of 2027/28 and 2027/28 respectively.

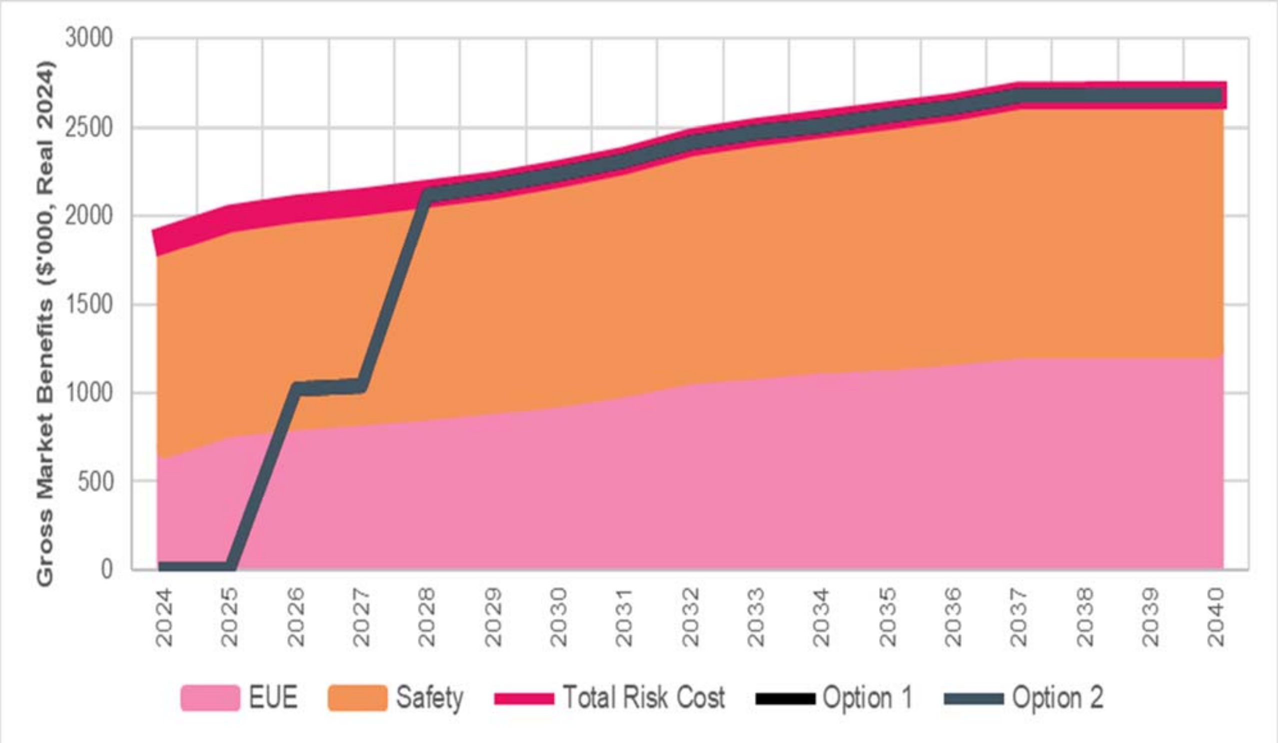

Figure 6: Gross Market Benefits: Central Scenario ($'000, Real 2024)

9.2 Net Market Benefits

Table 27 summarises the net market benefit in present value terms for each credible option over a 25-year analysis period, relative to the base case (Do Nothing). The net market benefit for Option 1 and Option 2 is the present value of gross market benefits, under the Weighted Scenario (as set out in Table 25 and Table 26 respectively), minus the present value of total investment costs of each option (as set out in Table 22).

The table also shows the corresponding ranking of each option under the RIT-D, with options ranked in the order of descending net market benefit.

Table 27: Net Market Benefits of Credible Options for the Weighted Scenario

Options	**Present Value ('000, Real 2024)**			
	Investment Cost	Gross Market Benefits	Net Market Benefits	Ranking Under RIT-D
Do Nothing	0	0	0	3
Option 1	25,921	33,194	7,274	1
Option 2	30,734	33,194	2,460	2

This RIT-D assessment demonstrates that Option 1 has the highest net market benefit under the Weighted Scenario.

9.3 Sensitivity Assessment

CitiPower has tested the robustness of the RIT-D assessment to the inclusion of a number of sensitivity tests around the input assumptions adopted. These sensitivities were presented in Table 24. Table 28 shows the results of these sensitivity studies.

Table 28: Present Net Market Benefits of Credible Options - Sensitivities ($'000, Real 2024)

Sensitivity for Central Scenario	Option 1	Option 2
All Variables: Base value	7,378	2,564
Maximum demand: Lower bound	5,836	1,049
Maximum demand: Upper bound	8,135	3,322
Capital and operational costs: Lower bound	12,649	8,799
Capital and operational costs: Upper bound	2,106	(3,670)
Value of customer reliability: Lower bound	4,347	(466)
Value of customer reliability: Upper bound	10,408	5,595
Discount rate: Lower bound	17,414	12,373
Discount rate: Upper bound	745	(3,659)
Asset failure rates: Lower bound	2,383	(2,430)
Asset failure rates: Upper bound	12,373	7,559

Option 1 has a present value of net market benefit that remains positive under all credible sensitivities, and when compared with Option 2, clearly maintains its status as the preferred option under all credible sensitivities.

Table 29 presents the net market benefits in NPV terms for each option across all reasonable scenarios considered.

Table 29: Present Value of Net Market Benefits of Credible Options - Scenarios ($'000, Real 2024)

Scenario	Do Nothing		Option 1		Option 2	
	Net Market Benefit	Ranking	Net Market Benefit	Ranking	Net Market Benefit	Ranking
Weighted	0	3	7,274	1	2,460	2
Central	0	3	7,378	1	2,564	2
Low	0	2	1,095	1	(3,718)	3
High	0	3	13,244	1	8,431	2

For all reasonable scenarios considered, Option 1 maximises the present value of net market benefits for all scenarios, including under the Weighted Scenario (i.e. a weighting of the Central, Low and High Scenarios).

Under the RIT-D, the preferred option should maximise the present value of the net market benefits to all those who produce, consume and transport electricity in the NEM when compared to other credible options and the base case. This RIT-D assessment, based on the sensitivity results in Table 28 and the scenario results in Table 29, demonstrates that Option 1 maximises the present value of net market benefits under all reasonable sensitivities and scenarios considered.

The preferred option for investment for the LQ supply area is therefore Option 1 which is to replace the existing LQ switchboard and secondary systems in the same substation building. This option satisfies the requirements of the RIT-D.

9.4 Economic Timing

The previous Sections 8.2 and 8.3 demonstrate Option 1 - Replace existing LQ switchboard and secondary systems in the same building, to be the preferred option to address the identified need. Although the choice of the preferred option is clear, the optimum timing of this investment is not, given a number of reasonable scenarios are investigated. The economic timing of the preferred option is when the annualised value of EUE and safety risk cost (i.e. the annualised cost of the total risk) exceeds the annualised cost of the preferred option (i.e. the annualised investment cost). Table 30 shows the expected timing of the preferred option under each reasonable scenario.

Table 30: Expected Timing of the Preferred Option

Scenario	Annualised cost of total risk minus investment costs ('000, Real 2024)				Optimum Timing Before Summer[22]
	2025	2026	2027	2028	
Weighted	701	753	795	836	2024/25
Central	705	757	799	840	2024/25
Low	243	281	312	343	2024/25
High	1,151	1,216	1,268	1,319	2024/25

While the optimum timing is identified as 2024/25, it is not practical to complete the works by this time. Therefore, considering the three-year lead time, under the Weighted Scenario the optimum timing of Option 1 is prior to summer 2027/28 (i.e. November 2027).

10. Preferred Option

Section 8 has presented the results of the NPV analysis conducted for this RIT-D assessment. This RIT-D assessment has demonstrated that Option 1 maximises the present value of net market benefits under all reasonable sensitivities and scenarios considered.

The preferred option for investment is therefore Option 1. This option involves a renewal of LQ's secondary systems and the 11 kV switchboard in the existing substation building, built to CitiPower's latest design standards.

This option addresses both the safety need and reliability need and maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the NEM, considering a set of reasonable state-of-the-world scenarios and their weightings.

The preferred option was tested under a range of sensitivities. In each case, Option 1 was confirmed to provide positive economic benefits in all sensitivities and is the highest-ranked option in all sensitivities.

The optimum timing for commissioning of the preferred option is no later than November 2027.

The preferred option has a capital cost of $28.96 million (Real, 2024).

11. Next Steps

This FPAR represents the final stage of the RIT-D process.

In accordance with the provisions set out in clause 5.17.5, paragraph (c) of the NER, Registered Participants or interested parties may, within 30 days after the publication of this report, dispute the conclusions made by CitiPower in this report with the Australian Energy Regulator (AER).

Accordingly, Registered Participants and interested parties who wish to provide submissions on the recommendations outlined in this report must do so by 1 December 2024. Any parties raising such a dispute are also required to notify CitiPower at ritdenquiries@citipower.com.au. If no formal dispute is raised, CitiPower will commence with the investment activities necessary to proceed with the implementation of the preferred option.

[22] The economic analysis concludes the optimum timing is 2024/25 however the preferred option cannot be constructed within this timeframe. Instead it can be constructed before the 2027/28 summer.

12. Checklist of Compliance with NER Clauses

This Section 12 sets out a compliance checklist which demonstrates the compliance of this FPAR with the requirements of clause 5.17.4, paragraph (r)(1) of the NER in Table 31.

Table 31: NER Requirements Checklist

NER Clause	Summary of Requirements	Relevant Section FPAR
5.17.4(j)(1)	A description of the identified need for investment	Section 4.2
5.17.4(j)(2)	The assumptions used in identifying the need (including, in the case of proposed reliability corrective action, why the RIT-D proponent considers reliability corrective action is necessary)	Section 5
5.17.4(j)(3)	Summary of, and commentary on, the submissions on the options non-network options report	Not Applicable
5.17.4(j)(4)	A description of each credible option assessed	Section 6
5.17.4(j)(5)	Where a Distribution Network Service Provider has quantified market benefits in accordance with clause 5.17.1(d), a quantification of each applicable market benefit for each credible option;	Section 9.1
5.17.4(j)(6)	A quantification of each applicable cost for each credible option, including breakdown of operating and capital expenditure	Section 8.3
5.17.4(j)(7)	A detailed description of methodologies used in quantifying each class of cost and market benefit	Section 8.1
5.17.4(j)(8)	Where relevant, the reasons why CitiPower has determined that a class or classes of market benefits do not apply to a credible option	Section 8.2
5.17.4(j)(9)	The results of a net present value analysis for each option and accompanying explanatory statements regarding the results	Section 9.2 Section 9.3
5.17.4(j)(10)	The identification of the preferred option	Section 10
5.17.4(j)(11)	Details of the preferred option including technical characteristics, construction timetable and commissioning date, the indicative capital and operating cost (where relevant), a statement and accompanying detailed analysis that the preferred option satisfies the RIT-D, if the preferred option is for reliability corrective action and that option has a proponent and the name of the proponent.	Section 10
5.17.4(j)(12)	Contact details for a suitably qualified staff member of the RIT-D proponent to whom queries on the final report may be directed.	Section 11
5.17.4(r)(1)(ii)	Summary of, and commentary on, the submissions on the Draft Project Assessment Report	Section 7

Appendix A: LQ Site Photos

Existing Email HQ compound filled double bus switch board - Bus A shown

Existing early 1970's electromechanical protection relays