CBD Security of Supply Upgrade Plan:

MP to BQ & WP 11 kV feeders

REGULATORY TEST REPORT

22 July 2014

Contents

1 Overview and Summary

Purpose

This regulatory test report has been prepared by CitiPower in accordance with the requirements of clause 5.6.2 of the National Electricity Rules ('the Rules')[1]. The document sets out the results of an analysis of options to address CitiPower's projected non-compliance with clause 3.1A.5 of the Electricity Distribution Code, which requires the company to implement the CBD Security of Supply Upgrade Plan.

The need for investment

Under the CBD Security of Supply Upgrade Plan ('the Upgrade Plan') CitiPower is required to provide an 'N-1 Secure' level of supply security to CBD load.

After 66 kV works under the Upgrade Plan are completed, significant load at risk will remain for an N-2 event involving the 66 kV cables connected to McIlwraith Place zone substation (MP). Unless additional distribution feeder capacity is constructed, CitiPower will be unable to ensure delivery of the 'N-1 Secure' standard in accordance with the Upgrade Plan.

Preferred network solution

The need for additional 11 kV feeder capacity to ensure delivery of the 'N-1 Secure' standard is recognised in the Upgrade Plan. In accordance with the Upgrade Plan, CitiPower proposes to address the need for investment by undertaking the following work:

- installation of 8 new 6.5 MVA 11 kV feeders from Bouverie Queensberry (BQ) Zone Substation to Exhibition Exchange distribution substation; and
- installation of 8 new 6.5 MVA feeders from WP into Lonsdale St to joint to the MP to 310 Latrobe St distribution Substation cables.

This work will enable 26 MVA of load to be transferred from MP zone substation, thereby mitigating N-2 load at risk on the 66 kV sub transmission cables connected to MP, and meeting the requirements of clause 3.1A.5 of the Electricity Distribution Code.

Scope of this report

This report:

- provides background information on the CBD Security of Supply Upgrade Plan;
- identifies the issues that need to be addressed in the context of the Upgrade Plan;
- identifies the possible options to address the issues;
- provides economic analysis of the options, conducted in accordance with the requirements of the regulatory test; and
- provides a conclusion setting out CitiPower's preferred network solution.

[1] In accordance with clause 11.50.5 of the current Rules, the provisions set out in clauses 5.6.2(e1) to (k) of version 53 of the Rules apply to the assessment of the options for addressing the issues identified in this report. Unless stated otherwise, all references to the Rules are to version 53.

Basis for selection of the preferred network solution

Four options were assessed under the reliability limb of the regulatory test. The preferred option was selected because:

- It is required to enable CitiPower to meet the strengthened security of supply objective for the Melbourne CBD set out in the Upgrade Plan, in accordance with the company's obligations under clause 3.1A.5 of the Electricity Distribution Code.

- It minimises the present value of costs, compared with a number of alternatives options in a majority of reasonable scenarios.

Under the Upgrade Plan, the additional 11 kV feeder capacity must be commissioned by no later than the end of 2017.

Conclusion

This report demonstrates that the proposed project - installation of 8 new 6.5 MVA 11 kV feeders from BQ to Exhibition Exchange combined with the installation of 8 new 6.5 MVA feeders from WP into Lonsdale St to joint to the MP to 310 Latrobe St Distribution Substation cables - meets the requirements of the regulatory test.

Accordingly, CitiPower will proceed to implement the project. Work will be staged, with the BQ to Exhibition Exchange cables to be installed by the end of 2016, and the WP to Lonsdale St works to be completed by the end of 2017.

2 Background: CBD Security of Supply Upgrade Plan

In February 2008, the Essential Services Commission (ESC) issued its Final Decision on the CBD Security of Supply Upgrade Plan[2]. The Final Decision amended the Electricity Distribution Code to include new provisions (in clause 3.1A) requiring CitiPower to strengthen the security of supply to the Melbourne CBD, in accordance with a plan that:

- specifies strengthened security of supply objectives for the Melbourne CBD;
- specifies the capital and other works proposed in order to achieve those objectives; and
- meets the regulatory test.

Under the Upgrade Plan, the level of supply security at CitiPower's 66 kV network level across the CBD will be increased, to provide a security standard of 'double back-up' or 'N-1 Secure'. Under this standard, CitiPower will have the ability to switch the network within 30 minutes of a high voltage outage, to enable it to withstand a second high voltage outage without loss of load.

The works that are planned to deliver the increased level of CBD supply security are set out in the ESC's Final Decision and associated documents[3], along with subsequent planning reports published by CitiPower, including:

- Distribution System Planning Reports prepared annually in accordance with clause 3.5 of the Electricity Distribution Code; and
- Distribution Annual Planning Reports prepared in accordance with the Rules[4].

3 Issues to be addressed by this project

CitiPower is currently undertaking the capital works required to implement the CBD Security of Supply Upgrade Plan. An overview of completed, in-progress and planned work is provided in CitiPower's 2013 Distribution Annual Planning Report, and further details are available from CitiPower's website at: http://www.citipower.com.au/Electricity_Networks/CitiPower_Network/CBDSupply/.

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2 Essential Services Commission of Victoria, *Final Decision: CBD Security of Supply*, February 2008.

3 These documents include a report by NERA (commissioned by CitiPower) prepared in accordance with the regulatory test, which assessed options for achieving the increased security standard. NERA's report concluded that CitiPower's preferred option (centred on the upgrade of Brunswick Terminal Station) was the most cost effective means to deliver the proposed increase in security of supply to CBD customers and that the benefits to customers outweighed the costs of sustained widespread outages in the CBD. Further information on the regulatory test assessment of the CBD security of supply project is available from AEMO's website at: http://www.aemo.com.au/Consultations/Network-Service-Provider/Joint/Proposed-Augmentation-for-Melbourne-Inner-Suburbs-and-CBD-Supply

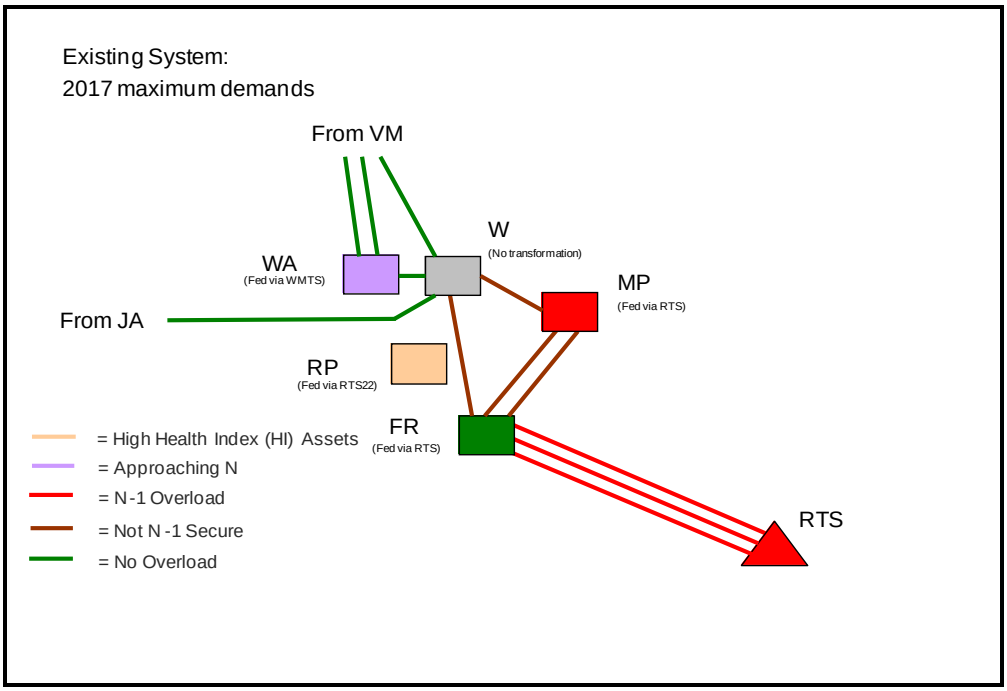
4 The 2013 report is available from: http://www.citipower.com.au/docs/pdf/Electricity%20Networks/CitiPower%20Network/CitiPower%20Distribution%20Annual%20Planning%20Report%202013%20-%20Rev%201.pdf

This regulatory test report is concerned with 11 kV works required to achieve the 'N-1 Secure' standard for load supplied from McIlwriath Place zone substation (MP). Figure 1 below shows an aerial photo of the Melbourne CBD, and the various zone substations (marked with red dots) supplying the eastern and northern CBD areas.

Figure 1: Melbourne CBD with eastern and northern zone substations shown

Figure 2 shows the existing 66 kV system configuration in relation to these zone substations.

Figure 2: Existing 66 kV system



Following the completion of planned 66 kV works required to meet load growth and to implement the CBD Security of Supply Upgrade Plan, the system will be augmented and reconfigured as shown in Figure 3 below.

Figure 3: 66 kV system after completion of CBD Upgrade Plan and planned capacity expansion works

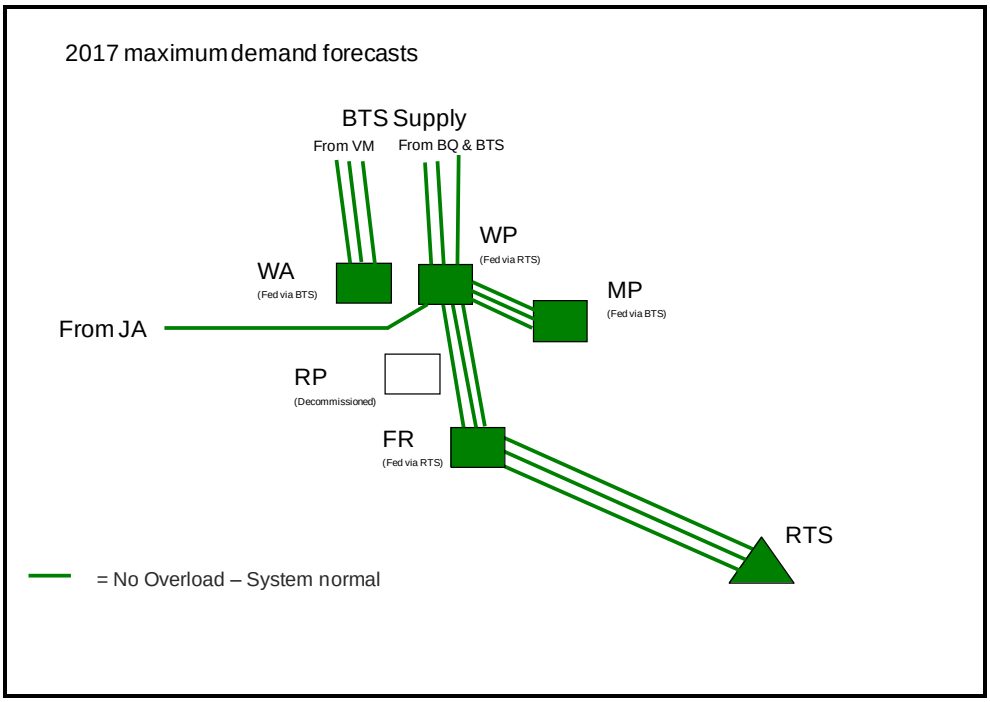


Figure 3 shows that under system normal conditions (all plant in service) loading on the 66 kV system is expected to remain within plant ratings. However, following completion of the 66 kV works shown above, there will still be insufficient capacity to meet all demand on the FR-MP subtransmission system under N-2 conditions.

Tables 1 and 2 below show the current and projected level of load at risk under N-2 conditions for FR-MP at the 50% and 10% probability of exceedence (PoE) demand forecasts. The projections set out in the tables below assume that the 66 kV works shown in Figure 3 are completed by no later than the end of 2017.

Table 1: Load at risk and expected unserved energy for FR-MP (N-2) at 50% PoE load forecast

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Load above N – 2 Rating (%)	66.0	70.6	71.3	76.5	79.2	81.8	84.7	87.3	90.2	93.0
Load at risk (MVA)	49.7	53.3	56.1	58.2	60.3	62.5	64.7	67.0	69.2	71.6
Energy at risk (MWh)	20,492	23,368	23,798	27,201	28,984	30,793	32,723	34,588	36,574	38,594
Hours at risk	1,124	1,163	1,169	1,221	1,248	1,278	1,313	1,351	1,390	1,432

Table 2: Load at risk and expected unserved energy for FR-MP (N-2) at 10% PoE load forecast

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Load above N – 2 Rating (%)	81	86	90	93	96	99	102	105	108	112
Load at risk (MVA)	62	66	69	71	73	76	78	81	83	86
Energy at risk (MWh)	31,017	34,518	35,040	39,191	41,373	43,590	45,961	48,254	50,703	53,188
Hours at risk	1,268	1,330	1,341	1,421	1,461	1,503	1,549	1,584	1,621	1,675

The data in Tables 1 and 2 indicate that there is significant load at risk for an N-2 event, even following completion of the planned 66 kV work shown in Figure 3.

Accordingly, without further distribution network investment, supply of load from MP zone substation will not meet the 'N-1 Secure' standard required under the CBD Security of Supply Upgrade Plan. Additional distribution network investment is therefore required to ensure that the strengthened security of supply objective for the Melbourne CBD is achieved in accordance with CitiPower's obligations under clause 3.1A.5 of the Electricity Distribution Code.

4 Options for addressing issues

4.1 Nature of options to be considered, and consistency with CBD Upgrade Plan

The 2008 Final Decision on the CBD Security of Supply Upgrade Plan noted that the ESC's engineering consultant (Maunsell) had determined that additional load transfers at the 11 kV distribution level would be needed to deliver 'N-1 Secure' in some scenarios.[5] The Final Determination proceeded to state the following[6]:

> "In September 2007, CitiPower was asked to provide supporting evidence that the load transfers from the 11 kV distribution network that Maunsell considered necessary to achieve N-1 Secure could be delivered.
>
> CitiPower responded that the 11 kV transfer capability is most efficiently built in conjunction with on-going load growth related augmentations. CitiPower advised there are numerous options available to achieve the required transfers, noted in Appendix B, with the final option chosen dependant on the nature, size and location of existing load growth and new customer loads.
>
> However, the Commission is concerned about the need for customers to receive an N-1 Secure level of security to the Melbourne CBD and the benefits of this higher security standard as proposed by CitiPower. CitiPower is effectively relying on these works at the distribution level to ensure customers served by substations MP, WA and LQ do not suffer an outage for the loss of two network elements simultaneously.
>
> Therefore, as part of its final decision, the Commission will require the projects noted in Appendix B.1.8 to be listed as additional to (and included in) CitiPower's CBD security of supply project plan, to be forwarded to the Commission as the security plan. It is noted that these works will not alter the security plan, as they are associated with

5 ESC of Victoria, *Final Decision: CBD Security of Supply*, February 2008, page 13.

6 Ibid, page 14.

> normal augmentation works carried out as part of CitiPower meeting growth in demand and connection of new customers. However the Commission is aware that without these works, or a combination of them, being completed by CitiPower, an N-1 Secure level of security will not be entirely delivered to the CBD once physical construction is completed as proposed in CitiPower's September 2006 plan.
>
> Based on CitiPower's September 2006 proposal the project would deliver an N-1 Secure level of security to CBD customers with the inclusion of additional augmentation works in Appendix B.1.8. The Commission expects that these works must be completed at the same time as the security works and be included in the regulatory accounts update of progress against that plan."

Appendix B.1.8 of the ESC's Final Decision lists a range of alternative additional distribution level works that CitiPower advised (in September 2007) could be undertaken in co-ordination with load growth projects to ensure delivery of the N-1 Secure standard. It states:

> "To maintain N-1 Secure at MP after a loss of one circuit, an additional load in the order of 26 MVA needs to be transferred away (over and above the available 15 MVA transfer capacity). This is achieved by the installation of 3 new, 12 MVA rated 11 kV feeders — 2 between LQ and MP (installed above) and one from MP to JA. The 2 feeders between LQ and MP will supplement each other for a contingency situation at either of these stations. In the future, a fourth feeder between MP and the proposed TP will be installed."

The CBD Security of Supply Upgrade Plan recognises the need for additional 11 kV feeder capacity to be installed, to achieve the 'N-1 Secure' standard. However, it does not prescribe a specific set of 11 kV investments.

In accordance with the Upgrade Plan, CitiPower has identified four potentially feasible options for providing additional 11 kV transfer capability from MP in order to ensure that the N-1 Secure standard for CBD supply is met. These options are described in the next section.

4.2 Description of options

The options considered by CitiPower to address the issues described in section 3 are outlined in Table 3 below.

Table 3: Potentially feasible options under consideration

Option	Description
1	**New 11 kV Feeders from BQ to Exhibition Exchange and WP to Lonsdale St** This option involves the construction of the following assets to enable load to be transferred from MP: • 8 new 6.5 MVA feeders from BQ to Exhibition Exchange Distribution Substation; and • 8 new 6.5 MVA feeders from WP into Lonsdale St to joint to the MP to 310 Latrobe St Distribution Substation feeders. This work is consistent with the need for 11 kV feeder capacity identified in the Upgrade Plan. It would transfer approximately 26 MVA from MP and would meet the requirement to deliver the N-1 Secure standard for the CBD. The estimated direct capital cost of this work is $6.68 million.
2	**New 11 kV feeders from WP to Exhibition Exchange and WP to Lonsdale St** Under this option, 8 new 6.5 MVA feeders would be constructed from WP to Exhibition Exchange Distribution Substation. As for Option 1, additional work involving the installation of 8 new 6.5 MVA feeders from WP into Lonsdale St to joint to the MP to 310 Latrobe St Distribution Substation feeders, would also be required. This work is consistent with the need for 11 kV feeder capacity identified in the Upgrade Plan. It would transfer approximately 26 MVA from MP and would meet the requirement to deliver the N-1 Secure standard for the CBD. The estimated direct capital cost of this option is $7.68 million. Further investigation would be required to confirm the feasibility of this option.
3	**New 11 kV feeders from BQ to 310 Latrobe St Distribution Substation and BQ to Exhibition Exchange** Under this option, 8 new 6.5 MVA new feeders would be constructed from BQ to 310 Latrobe St Distribution Substation. As for Option 1, additional work involving the installation of 8 new 6.5 MVA feeders from BQ into to Exhibition Exchange Distribution Substation feeders, would also be required This work is consistent with the need for 11 kV feeder capacity identified in the Upgrade Plan. It will transfer approximately 26 MVA from MP and would meet the requirement to deliver the N-1 Secure standard for the CBD. The estimated direct capital cost of this option is $11.5 million.
4	**New 11 kV feeders from BQ to 310 Latrobe St Distribution Substation and WP to Exhibition Exchange** Under this option, 8 new 6.5 MVA new feeders would be constructed from BQ to 310 Latrobe St Distribution Substation. As for Option 1, additional work involving the installation of 8 new 6.5 MVA feeders from WP into to Exhibition Exchange Distribution Substation feeders, would also be required. This work is consistent with the need for 11 kV feeder capacity identified in the Upgrade Plan. It will transfer approximately 26 MVA from MP and would meet the requirement to deliver the N-1 Secure standard for the CBD. The estimated direct capital cost of this option is $14.5 million.

5 Economic assessment of options

5.1 Application of reliability limb of the regulatory test

Based on the information presented in sections 3 and 4, it is evident that:

- CitiPower must take action - by installing additional transfer capability at the 11 kV distribution level - in order to meet its obligations under clause 3.1A.5 of the Electricity Distribution Code to deliver an 'N-1 Secure' level of security to the CBD.

- The options under consideration will ensure that this compliance obligation is met.

- Each of the options under consideration is consistent with the CBD Security of Supply Upgrade Plan that was the subject of the ESC's February 2008 Final Decision.

Accordingly, the economic assessment of options under the regulatory test will proceed under the reliability limb of the test. The reliability limb is intended for use in assessing network investments to be undertaken to meet minimum network performance requirements - in this case, the requirements set out in clause 3.1A of the Electricity Distribution Code. The reliability limb is set out in clause 1(a) of the regulatory test, which states:

> "An option satisfies the regulatory test if in the event the option is necessitated solely by the inability to meet the minimum network performance requirements set out in schedule 5.1 of the Code or in relevant legislation, regulations or any statutory instrument of a participating jurisdiction – the option minimises the present value of costs, compared with a number of alternatives options in a majority of reasonable scenarios."

Clause 19 of the regulatory test defines reasonable scenarios as those incorporating reasonable and mutually consistent:

- forecasts of demand, and operating and capital costs;

- market development scenarios; and

- sensitivity testing.

In this particular case, market development scenarios are not expected to have any impact on the assessment of the alternative options to address the issues described in section 3, so they are not considered further.

In relation to sensitivity testing, it is noted that clause 23 of the regulatory test states that such testing may be carried out, and should be appropriate to the size and type of project. Clause 23 identifies the following variables that may be subject to sensitivity testing: value of customer reliability; price elasticity of demand; capital and operating costs of options; discount rate; market demand; and commissioning dates of the options being assessed.

5.2 Assessment of options - central assumptions and sensitivities

The four feasible options all involve installation of distribution feeders that have identical expected lives and cost structures[7]. It is therefore possible to derive a valid economic ranking of the options on the basis of their respective capital costs.

The options also involve similar installation timeframes and expenditure profiles. Given the magnitude of the differences in the capital costs of the four options it is therefore not necessary to apply a discount rate to evaluate the present value cost of each option.

Accordingly, Table 4 below presents a ranking of the options based on their direct capital costs.

Table 4: Ranking of options

Option	Direct Capital cost	Ranking
1. Install new 11 kV feeders from BQ to Exhibition Exchange Distribution Substation, and from WP into Lonsdale St	$6.68 million	First. This is the preferred option
2. Install new 11 kV feeders from WP to Exhibition Exchange Distribution Substation, and from WP into Lonsdale St	$7.68 million	Second
3. Install new 11 kV feeders from BQ to 310 Latrobe St Distribution Substation, and from BQ to Exhibition Exchange Distribution Substation	$11.5 million	Third
4. Install new 11 kV feeders from BQ to 310 Latrobe st Distribution substation, and WP to Exhibition Exchange Distribution Substation	$14.5 million	Fourth

Given the similar technologies and cost structures of each option, their relative ranking will not be affected by changes in assumed capital and / or operating costs. It is therefore not necessary to undertake sensitivity testing of those variables.

Given the driver of the need for investment - namely, compliance with clause 3.1A.5 of the Electricity Distribution Code - the relative rankings of the options will be unaffected by changes in variables such as the value of customer reliability, price elasticity of demand, and market demand. It is therefore not necessary to undertake sensitivity testing of those variables.

On the basis of this analysis, CitiPower proposes to implement Option 1. CitiPower proposes to co-ordinate the implementation of Option 1 with other work that is being undertaken as part of the CBD Security of Supply Upgrade Plan, to ensure that the required 26 MVA of 11 kV feeder capacity is in place by the end of 2017. Accordingly, implementation of Option 1 will be staged as follows:

[7] That is, the ratio of direct capital expenditure to total operating and maintenance expenditure over the asset life cycle.

- the BQ to Exhibition Exchange cables will be installed by the end of 2016; and
- the WP to Lonsdale St works will be completed by the end of 2017.

6 Conclusion

Under the CBD Security of Supply Upgrade Plan (approved by the ESC in February 2008), CitiPower is required to provide an 'N-1 Secure' level of supply security to CBD load. CitiPower is currently undertaking upgrade works in accordance with the Upgrade Plan, and these works are expected to be completed by the end of 2017.

Analysis indicates that there will be significant load at risk for an N-2 event involving the 66 kV cables connected to MP zone substation, even following completion of the 66 kV work required under the Upgrade Plan. To address this issue, the Upgrade Plan also encompasses the installation of additional 11 kV feeder capacity to ensure delivery of the 'N-1 Secure' standard.

In accordance with the Upgrade Plan, CitiPower proposes to address the identified issue by installing additional 11 kV distribution feeder capacity.

Four options were assessed under the reliability limb of the regulatory test. The preferred option is to install 8 new 6.5 MVA feeders from BQ to Exhibition Exchange Distribtion Substation, combined with the installation of 8 new 6.5 MVA feeders from WP into Lonsdale St to joint to the MP to 310 Latrobe St Distribution Substation cables. This work will enable 26 MVA of load to be transferred from MP zone substation.

Delivery of the work required for Option 1 will be staged, with the BQ to Exhibition Exchange cables to be installed by the end of 2016, and the WP to Lonsdale St works to be completed by the end of 2017. The proposed delivery schedule accords with the CBD Security of Supply Upgrade Plan, which requires the additional 11 kV feeder capacity to be commissioned by no later than the end of 2017.

In accordance with the reliability limb of the regulatory test, the preferred option is selected because:

- It is required to enable CitiPower to meet the strengthened security of supply objective for the Melbourne CBD in accordance with the company's obligations under clause 3.1A.5 of the Electricity Distribution Code.
- It minimises the present value of costs, compared with a number of alternatives options in a majority of reasonable scenarios.