AUSTRALIAN ENERGY REGULATOR

APPLICATION OF RIT-D REQUIREMENTS BY AUSGRID

SYDNEY CBD PROJECT

OCTOBER 2018

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Application of RIT-D requirements by Ausgrid Sydney CBD project

Australian Energy Regulator

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1 INTRODUCTION AND KEY FINDINGS

1.1 BACKGROUND

On the 8th June 2018, Ausgrid published their Final Project Assessment Report (FPAR) for the *Ensuring reliability requirements in the Sydney CBD* (Sydney CBD) project under the requirements for the Regulatory Investment Test for Distribution (RIT-D).

The FPAR considers options to address the increasing likelihood of equipment failure at the City East (CE) and Dalley Street (DS) zone substations. The identified need is the deteriorating condition of key assets that, if left unaddressed, would result in equipment failure with the primary consequences of:

— loss of supply to customers; and

— potential breaches of minimum feeder reliability standards that are part of Ausgrid's licencing conditions.

The purpose of the RIT-D is to identify the option that maximises the present value of the net economic benefit for all stakeholders. The preferred solution identified by the FPAR is to transfer all load from CE and DS zone substations to the existing City North and Belmore Park zone substations. The project was commenced prior to the change to the National Electricity Rules (NER) in November 2017 that required a RIT-D to be issued for projects whose primary purpose was asset replacement. As a result, the FPAR only considers the final stage of the project that involves the construction of new underground cable feeders that will transfer 90 MVA of load from CE and DS to Belmore Park. CE and DS will then be decommissioned and the existing assets removed.

The RIT-D allows for the preferred credible option to have a net negative economic benefit where the identified need is for reliability corrective action[1].

The economic benefits attributed to the project were a reduction of expected unserved energy and a reduction in maintenance, safety and environmental costs due to decommissioning and removal of the existing equipment. The valuation of the expected unserved energy uses a Value of Customer Reliability (VCR) of $170 per kWh.

On the 2nd July 2018 the Energy Users Association of Australia (EUAA) lodged a dispute with the Australian Energy Regulator (AER) regarding the VCR applied by Ausgrid. The basis of the dispute lodged by the EUAA is that the VCR used by Ausgrid was inconsistent with what they term the 'agreed Sydney CBD value' that was used by TransGrid and Ausgrid as the basis for their Powering Sydney's Future project.

The National Electricity Rules (NER) clause 5.17.5 sets out the process and requirements for disputes with respect to the RIT-D. Disputes can be lodged on the grounds that:

— the RIT-D proponent has not applied the RIT-D in accordance with the NER; or

— there was a manifest error in the calculations performed by the RIT-D proponent in applying the RIT-D.

This report considers the dispute and more broadly how Ausgird applied the requirements of the RIT-D when assessing the identified need and any potentially credible options to resolve the need.

1.2 PURPOSE OF THIS REPORT

WSP has been engaged by the AER to undertake an independent review of Ausgrid's Sydney CBD RIT-D to identify whether it is consistent with the regulatory requirements. This review will assist the AER in making its dispute determination.

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[1] NER Clause 5.17.1(b)

As part of the dispute resolution process, the AER advised the scope of the assessment is not only restricted to the issue of VCR raised by the disputing parties, but any broader compliance issues identified to ensure that there hasn't been a misapplication of the test or manifest error in the calculation (in accordance with cl. 5.17.5).

Specifically, the purpose of this report is to assess:

— whether the RIT-D has been applied in accordance with the NER, the RIT-D itself and the AER's RIT-D Application Guidelines; or manifest error in the calculations performed by Ausgrid

— and if it is found that Ausgrid incorrectly applied the RIT-D, whether this is likely to have materially affected the identification of the preferred option for this RIT-D assessment.

To undertake this assessment WSP reviewed the FPAR, Non Network Options Notice and supporting models. We undertook an interview with key staff to understand details of the of the models and requested additional information required.

1.3 KEY FINDINGS

WSP considers that the VCR for the CBD area is likely to be higher than for the state in general or when including the inner suburbs, so a VCR of greater than $90 is not unreasonable. Based on the analysis undertaken by Houston Kemp that leveraged off the survey findings from AEMO and Oakley Greenwood, we consider that $170/kWh is not inappropriate and has been identified and applied in alignment with the NER.

In addition, WSP finds:

— the FPAR was consistent with the RIT-D requirements in all material respects.

— the preferred option to undertake construction of new underground cable feeders that will transfer 90 MVA of load from zone substations CE and DS to Belmore Park is not impacted by variations to key inputs, including to reasonable choices in the value of VCR.

— WSP found that the preferred date proposed for the project by Ausgrid of 2025 is not inappropriate. WSP found that based on the expected values of costs and benefits, the optimal NPV occurs for a commission date of 2026, however, the difference in the NPV is not material and therefore commissioning in 2025 is reasonable to remove the risks of failure at the earliest economic date.

1.4 STRUCTURE OF THIS REPORT

This report is set out in the following sections:

— Section 2 considers the requirements for the RIT-D in relation to the values assigned to market benefits, specifically the matter of the dispute being the value of VCR applied by Ausgrid

— Section 3 sets out the results of our assessment of the application of the RIT-D

— Section 4 discusses WSPs analysis of market benefits and sensitivity analyses undertaken

2 VALUE OF CUSTOMER RELIABILITY

In this section, Ausgrid's application of VCR in its Final Project Assessment Report is assessed for compliance with the NER requirements. This assessment is intended to provide the AER with relevant information for their consideration in responding to the dispute lodged by EUAA.

2.1 THE DISPUTE

EUAA has lodged a dispute with AER. The dispute is in relation to the value of customer reliability (VCR) used by Ausgrid in the assessment of Ausgrid's "Ensuring reliability requirements in the Sydney CBD area" project, which was published as a Final Project Assessment Report (FPAR) on 8th June 2018. In the dispute papers, EUAA state that:

"Ausgrid have used a Sydney CBD VCR value of $170/kWh which is inconsistent with the agreed Sydney CBD value of $90/kWh used by TransGrid and Ausgrid as the basis for their Powering Sydney's Future project."

Additional matters set out by the EUAA in their dispute include:

— the $170/kWh value was not accepted by IPART, instead $90/kWh was considered appropriate

— that the basis of the VCR is predominately based on desktop studies originating from the AEMO 2014 survey and 2012 Oakley Greenwood report

— there was insufficient sensitivity or scenario analysis undertaken.

2.2 AUSGRID'S APPROACH

In its Final Project Assessment Report, Ausgrid states:

"Ausgrid has applied a central VCR estimate of $170/kWh based on the mid-point of a range estimate of VCR for the Sydney CBD by Houston Kemp in 2017. This value considers that the $90/kWh VCR estimate proposed in the recent Independent Pricing and Regulatory Tribunal (IPART) review of the transmission reliability standards is an average for the Inner Sydney area, with lower VCR estimates for several sub-sections of the network area – such as $40/kWh which we have used for Canterbury- Bankstown, Inner West or Lower North Shore- and higher VCR estimates for Sydney CBD.

This approach recognises that there is higher-than average economic output produced by the CBD customers supplied from City East and Dalley St zone substations. We have also investigated the effect of assuming both a lower underlying VCR estimate. The lower sensitivity is based on the $90/kWh VCR estimate for Inner Sydney, consistent with the recent IPART review of the transmission reliability standards for Inner Sydney, as well as the recently finalised Powering Sydney's Future RIT-T."

Ausgrid applied the VCR value of $170 per kWh in its assessment of involuntary load shedding.

2.3 HAVE THE REQUIREMENTS FOR VCR BEEN MET?

The NER contains requirements for the application of the RIT-D relating to market benefits. The key requirements in relation to the dispute are those that apply to the value of market benefits, specifically the VCR.

The NER requires that the RIT-D proponent consider whether each credible option could deliver specified market benefits. One of the benefits specified are changes in involuntary load shedding and customer interruptions caused by network outage. The RIT-D guidelines provide further clarification regarding how the involuntarily interrupted load should be quantified and how the value of electricity to customers should be selected.

2.3.1 REVIEW APPROACH

The following approach has been taken to assess whether VCR has been correctly applied in accordance with the RIT-D:

- Assess the VCR value against the NER requirements for RIT-D and the AER's guidelines
- Test the stated and implied assumptions for reasonableness
- Undertake sensitivity analysis to test whether the application of a different value would impact on the preferred project option

2.3.2 DEFINITION OF VCR

The VCR is defined in the RIT-D guidelines as "the value that electricity customers place on avoiding service interruptions. The VCR determines how much customers are willing to pay for improved service".

Neither the NER nor the guidelines specify a value for the VCR. The guidelines state the reduction in involuntary load shedding can be valued as a market benefit derived by:

- the quantity (in MWh) of involuntary load shedding not required due to the credible option, multiplied by
- a reasonable forecast of the value of electricity to consumers (in $/MWh) not shed due to the credible option.

WSP notes that Ausgrid has correctly defined VCR and applied it in its Cost Benefit Analysis (CBA) in accordance with these requirements.

2.3.3 REASONABLE VALUE FROM A REPUTABLE SOURCE

The guidelines state that a RIT-D proponent should use a reasonable measure of the value of customer reliability (VCR) in calculating market benefits. A RIT-D proponent should also use VCR estimates from a reputable source, such as the VCR used by AEMO for network planning in Victoria.

In 2012, Oakley Greenwood published as study of VCR that was commissioned by the AEMC. The study took the form of customer surveys and resulted in a VCR segmented by customer type (residential, small business and large business) and feeder type (CBD, Urban and Rural). The average VCR across all feeder types and customers was $94.99/kWh, and for CBD feeder type the average across all customer types was $120.52 (in 2012 dollars).

The most recent survey of customers' preferred value of reliability was undertaken by AEMO in 2014. AEMO established VCR values for residential, agricultural, commercial and industrial customers and found that the average state wide VCR for NSW was $33.46/kWh (in 2014 dollars)[2].

In 2016, Houston Kemp undertook a study of VCR based on the 2012 study from Oakley Greenwood and 2014 study by AEMO. Huston Kemp considered the applicability of each customer segment from each study to the Sydney CBD to determine a current value of VCR for each customer type within the CBD. They then applied a demand weighted sum of VCR by customer type and determine the likely range of VCR to be between $150/kWh and $192/kWh (in 2015/16 dollars).

Ausgrid have used a VCR that took the midpoint of the range determined by the Houston Kemp study. Houston Kemp and Oakley Greenwood are qualified economists and experienced in regulatory economics and their analysis is based on historical customer surveys. This would appear to satisfy the requirement to use VCR estimates from a reputable source.

The reasonableness of the VCR estimate can be assessed by examining the assumptions made by Houston Kemp in developing the estimate. WSP considers that the key assumptions considered by Houston Kemp when assessing the VCR were:

- A different VCR should apply in the CBD area from that applied in the inner Sydney area or state-wide

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2 Australian Energy Market Operator, 2014, Value of customer reliability review final report

— Economic value is an appropriate scaling factor.

Each of these assumptions are discussed below.

DIFFERENT VCR SHOULD APPLY TO SYDNEY CBD AREA

In 2016, consultants Houston Kemp reported on an appropriate VCR to be used in the joint TransGrid/Ausgrid study on Powering Sydney's Future, a study of electricity supply to the CBD and Inner Metro sub-regions of Sydney. Ausgrid used the VCR recommended by Houston Kemp in the Cost Benefit Analysis for the Sydney CBD project.

Houston Kemp considered the AEMO established VCR values for residential, commercial and industrial customers and the average state wide VCR for NSW of $33.46/kWh (in 2014 dollars). The Houston Kemp report discusses the reasons for applying a different value for VCR in sub-regions, specifically in the inner Sydney or Sydney CBD areas. It noted that the AEMO study was based on a low stratification of geographical areas and customer segments. It noted that the study did not specifically consider sub-regions such as CBD areas, that is, it considered the VCR for all customer segments of residential, commercial and industrial to be equal across the state. Additionally, the AEMO study did not consider long duration outages that might occur in the Sydney CBD area.

In its 2016 study of Electricity transmission reliability standards, IPART accepted that a different VCR should apply to the inner Sydney area and adopted the VCR recommended by Houston Kemp for the inner Sydney area.

WSP accepts the arguments put forward by Houston Kemp. It also notes:

— In developing VCR values for specific transmission connection points, IPART adopted a weighted average value based on the actual customer mix supplied.[3] In principle, developing a specific VCR for a transmission connection point is no different than developing a specific VCR for the Sydney CBD area.

— CBD areas are unique in the mix of customers, have a dominance of high rise buildings with high demands for electricity, have a dominance of business customers who rely on e-commerce and an associated high reliance on a reliable electricity supply. It is evident that a different value should be placed on electricity in CBD areas compared to other areas.

WSP concludes that the Houston Kemp assumption that the VCR applied to the Sydney CBD area should be different to the VCR applied to the Sydney inner suburban area or state-wide values is a reasonable assumption.

SCALING FACTOR

Houston Kemp assessed a number of metrics proposed by Ausgrid that could reflect an appropriate scaling factor to adjust the AEMO VCRs from a state-wide average by customer class to a Sydney CBD specific value. The use of GDP generated by the Sydney CBD compared to the state average GDP was selected as the most appropriate. Other scaling factors which resulted in higher estimates of VCR were proposed by Ausgrid but refuted by Houston Kemp as less applicable. The methodology adopted was:

— Obtain preliminary CBD VCR by demand weighting AEMO customer VCRs by customer demand breakdown in the CBD.

— Apply various uplift multipliers to preliminary VCR to account for differences in (i) economic contribution, (ii) STPIS targets and (iii) value of floor rental.

This method resulted in a VCR of $191/kWh.

Houston Kemp also assessed VCR using a separate approach based on the outcomes of the survey studies undertaken by Oakley-Greenwood in 2012 and AEMO in 2014. They calculated a demand weighted sum of VCR across customer types, with the VCR per customer type based on the following:

— Residential – used the AEMO VCR

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3 IPART, 2016, Electricity transmission reliability standards

— Commercial small & medium – lower bound calculated by using Oakley-Greenwood NSW state-wide VCR, upper bound calculated by escalating Oakley-Greenwood NSW state-wide VCR by 50% to reflect a consistent ratio between CBD feeder results and all NSW feeder results

— Commercial large – used the Oakley-Greenwood CBD VCR.

Houston Kemp found that a CBD average VCR of $150-192/kWh (in $2015/16) was appropriate, with a relative standard error (RSE) of 32%. For its Sydney CBD project, Ausgrid selected the midpoint of the range recommended by Houston Kemp for CBD areas, $170 per kWh.

In the same report, Houston Kemp found that $90 per kWh was an appropriate value for the broader area of inner Sydney, including five inner Sydney bulk supply points (Beaconsfield West, Haymarket, Rookwood Rd, Sydney North and Sydney South) as a single group. IPART accepted this value in its 2016 review of transmission reliability standards.

WSP notes that that the two approaches resulted in comparable estimates for the VCR in the Sydney CBD. The actual calculations were not reviewed, but the description of the calculation above appears to be sound. In particular:

— In its 2014 study, AEMO found a direct link between VCRs for business customers and ABS input-output (I-O) economic accounts. It modelled several accounts such as the net use of electricity and Australian production and found consistency in the derived VCR values. The approach to scaling adopted by Houston Kemp is based on a similar premise that VCR values vary in response to economic value.

— Basing economic value on key indicators of economic contribution (GDP) appears appropriate for a CBD area assessment.

— The categorisation of customers into residential, commercial small & medium, and commercial large aligns with the AEMO VCR study and allows the average VCR to be based on the actual customer mix in the Sydney CBD area.

— The use of upper and lower bounds for the customer category commercial small & medium provides the full possible range of VCR values as:

  a The lower bound is based on surveys that targeted the specific losses suffered by commercial businesses; and

  b The upper bound is based on a consistent ratio observed from the Oakley-Greenwood study between the VCR estimated across feeders state-wide, and that estimated across CBD feeders only[4].

— The use of CPI to escalate the VCR values is consistent with the application of VCR under the AER's guidance for its Service Target Performance Incentive Scheme.

These points provide assurance that the methodology used to determine an average VCR value for the Sydney CBD are not unreasonable, however, there is still uncertainty given that:

— the AEMO study used as the basis for the residential VCR estimate is now four years old

— the Oakley Greenwood study used as the basis for the commercial VCR estimate is now six years old

— as noted by Houston Kemp, an increasing number of CBD buildings have standby generation to cover short term outages

— new CBD building precincts may now be less dependent on electricity provided by networks given the increasing attention given to reducing energy usage, utilising solutions such as solar radiation for heating and shading for cooling. Wind and solar generation are commonly incorporated into the building design. These matters will impact on the appropriate VCR for these customers, making the newer constructions less reliant on electricity.

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4 Houston Kemp, 2016, CBD and Inner Metro VCR estimates, pg. 21

WSP concludes that there has not been any evidence that the value of VCR as $170/kWh for the Sydney CBD is unreasonable. The approach used to estimate the relative value of energy does not appear unreasonable and are considered likely to reflect an appropriate value for VCR.

In the absence of clear data, however, care in the application of the VCR needs to be taken. Houston Kemp noted in its report the uncertainty in the estimated values. It concluded that:

"Although we consider our estimated range for the VCR value for the CBD to be reasonable, based on the available information, we also note that it is likely to under-estimate the true VCR of CBD customers, particularly for the types of long-duration outages that are being considered in the PSF study."[5]

The impact of uncertainty can be assessed through sensitivity analysis to assess whether the VCR could result in a misapplication of the RIT-D, or a change to the preferred option selected.

2.3.4 SENSITIVITY ANALYSIS

NER Clause 5.17.1(c)(9)(iv) requires that a sensitivity analysis is required for modelling the cost-benefit analysis. Ausgrid investigated the effect of assuming a lower underlying VCR estimate based on the $90/kWh VCR estimate for Inner Sydney, consistent with the recent IPART review of the transmission reliability standards for Inner Sydney, as well as the recently finalised Powering Sydney's Future RIT-T. This would appear to meet the NER requirement.

Ausgrid used a Project Timing model to determine the optimal date for addressing City East and Dalley Street separately. Ausgrid then selected the latest date as the optimal timing date. For a VCR of $170/kWh, the Ausgrid Project Timing model finds that the optimal date for City East is 2025 and for Dalley St is 2018. Ausgrid selected 2025 as the optimal date.

WSP prefers to use the optimal date calculated for the entire project as this better considers the common solution proposed for the two substations and aligns to the approach used by Ausgrid in the CBA model. When the same calculation is done for the entire project, using the cost and benefits developed by Ausgrid, we found the optimal date to be 2022.[6]

WSP tested the reasonableness of the approach used by Ausgrid in the sensitivity test, and hence whether the VCR value chosen could result in a misapplication of the RIT-D. Using the timing model provided by Ausgrid, but considering the entire project rather than each substation separately, WSP tested if the timing of the project was sensitive to the VCR. The following outcomes were identified:

- The sensitivity analysis demonstrated that the preferred option did not change and remained as option 2 in all cases. Hence, the value of the VCR is not material in changing the selection of the preferred option.
- Varying VCR and holding all other inputs constant in the Project Timing model produced the results shown in Figure 2.1, which indicates that the optimal timing of the project is not impacted for the range of values for VCR determined by Houston Kemp for the Sydney CBD area ($150 to $190/kWh) and is insensitive to values of VCR above $100/kWh, varying the timing by only one year.
- We note that applying a VCR of $90 kWh as used by Ausgrid for the Inner Sydney area in its Powering Sydney's Future Project would delay the optimal project timing by only two years.

A further sensitivity analysis varying costs and key inputs was undertaken and the results on the optimal timing are set out in section 4.

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5 Ibid, pg 22

6 Note that the construction period is 5-years, making the earliest practical completion date 2024.

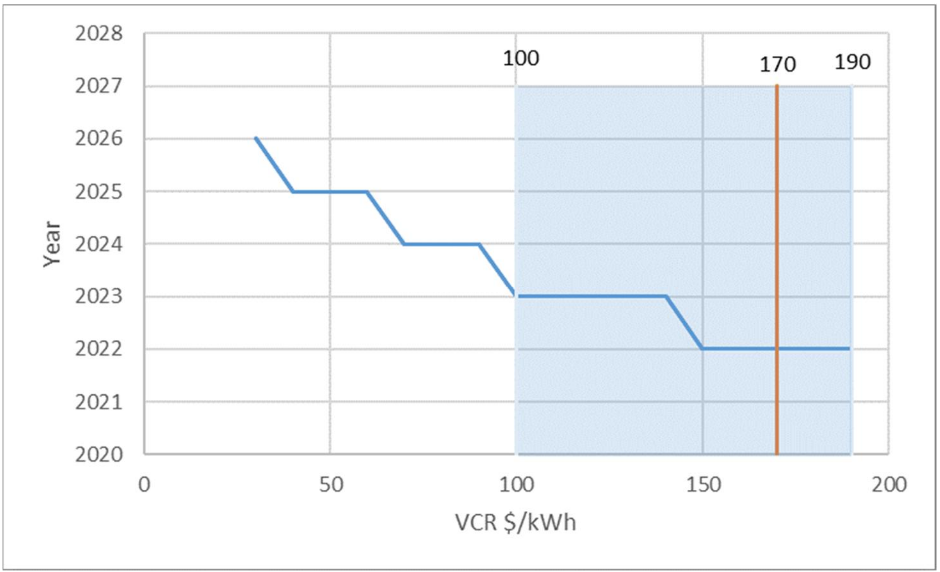

Figure 2.1: Changes in project timing for varying values of VCR (using costs and benefits developed by Ausgrid)

WSP notes that IPART undertook a sensitivity analysis when deciding whether to adopt a VCR of $90/kWh in its 2016 study of Electricity transmission reliability standards for the inner Sydney area. It noted that its modelling showed that 0.6 minute of outages per year was appropriate against current performance of 0 minutes per year. Adopting a lower VCR would further decrease performance from that currently experienced, suggesting that a lower VCR would not be appropriate. WSP notes that the same methodology was applied by Houston Kemp to determining an appropriate VCR for the CBD area.

2.4 CONCLUSION

The review undertaken by WSP shows that Ausgrid has applied the VCR in accordance with the requirements. The reasons for our finding is summarised in Table 2.1.

Table 2.1 Summary of findings on VCR

REQUIREMENT	ASSESSMENT	MET?
RIT-D guideline requirements for the application of VCR to use VCR estimates from a reputable source	VCR estimated by Houston Kemp based on AEMO and Oakley Greenwood survey based studies. Houston Kemp are qualified economists and experienced in regulatory economics.	Yes
Use a reasonable forecast of the value of electricity to customers	Assumptions made about applying a different VCR and the approaches taken to calculate it are not unreasonable	Yes
Consider whether each credible option could deliver specified market benefits	Appropriate market benefits have been included in the CBA. Sensitivity analysis indicates that reliability benefits can be achieved under low, medium and high scenarios.	Yes

Further, WSP found that the selection of the preferred project option and project timing is insensitive to any reasonable value of VCR.

3 OTHER REQUIREMENTS

In this section, Ausgrid's Final Project Assessment Report is assessed for compliance with the NER requirements. In undertaking this review, WSP relied on additional information provided by Ausgrid to the AER.

3.1 REQUIREMENTS FOR THE RIT-D

The NER sets out the requirements for the RIT-D in Clause 5.17.1 (c). The requirements are that the RIT-D must:

1. be based on a cost-benefit analysis that must include an assessment of reasonable scenarios of future supply and demand;
2. not require a level of analysis that is disproportionate to the scale and likely impact of each of the credible options being considered;
3. be capable of being applied in a predictable, transparent and consistent manner;
4. require the RIT-D proponent to consider whether each credible option could deliver [certain] classes of market benefits;
5. with respect to the classes of market benefits, ensure that, if a credible option is for reliability corrective action, the consideration and any quantification assessment of these classes of market benefits will only apply insofar as the market benefit delivered by that credible option exceeds the minimum standard required for reliability corrective action;
6. require the RIT-D proponent to consider certain classes of costs;
7. require a RIT-D proponent, in exercising judgement as to whether a particular class of market benefit or cost applies to each credible option, to have regard to any submissions received on the non-network options report and/or draft project assessment report where relevant;
8. provide that any market benefit or cost which cannot be measured as a market benefit or cost to persons in their capacity as Generators, Distribution Network Service Providers, Transmission Network Service Providers or consumers of electricity must not be included in any analysis under the regulatory investment test for distribution.

Clause 5.17.1(c)(9) requires that the RIT-D specify:

- i the method or methods permitted for estimating the magnitude of the different classes of market benefits;
- ii the method or methods permitted for estimating the magnitude of the different classes of costs;
- iii the appropriate method and value for specific inputs, where relevant, for determining the discount rate or rates to be applied;
- iv that a sensitivity analysis is required for modelling the cost-benefit analysis; and
- v that the credible option that maximises the present value of net economic benefit to all those who produce, consume or transport electricity in the *National Electricity Market* may, in some circumstances, be a negative net economic benefit (that is, a net economic cost) where the *identified need* is for reliability corrective action.

Clause 5.17.1(c)(d) requires that a RIT-D proponent may, under the *regulatory investment test for distribution*, quantify each class of market benefits under paragraph (c)(4) where the RIT-D proponent considers that:

1. any applicable market benefits may be material; or
2. the quantification of market benefits may alter the selection of the preferred option.

The regulatory investment test for distribution permits a single assessment of an integrated set of related and similar investments.

Further, the NER also sets out in clause 5.17.1(c)(4) that changes in involuntary load shedding and customer interruptions caused by network outages must use a reasonable forecast of the value of electricity to customers.

Additional to these requirements, clause 5.17.4 sets out the procedures to be followed in undertaking a RIT-D. This clause also specifies the contents for a project assessment report. For ease of assessment, the structure set out in clause 5.17.4(j) has been used in this report when assessing whether the RIT-D has been applied in accordance with the NER.

3.2 ASSESSMENT

The results of WSP's assessment is set out in Table 3.1. Two inconsistencies were found, however, these have no impact on Ausgrid's analysis. This assessment concludes that the FPAR is consistent with the RIT-D requirements in all material respects.

Table 3.1 Assessment of FPAR compliance with requirements

ITEM	REQUIREMENT	ASSESSMENT	MET?
Project need and the base case	Include: (1) a description of the *identified need* for the investment (2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, reasons that the RIT-D proponent considers reliability corrective action is necessary).	A detailed description of need is included. Assumptions have been provided, including: — Forecast demand for electricity — Forecast impacts on reliability	Yes
Non-network options	The RIT-D proponent must publish a non-network options report (unless there are no credible non-network options) and include in the DAPR a summary of, and commentary on, the submissions on the non-network options report.	The FPAR and Non Network Options Notice demonstrate that no viable non-network options exist. Hence a non-network options report is not required to be published.	Yes
Credible options considered	Include a description of each credible option. The RIT-D must be based on a cost-benefit analysis that must include an assessment of reasonable scenarios of future supply and demand.	Descriptions of credible options are provided. CBA provides NPV of credible options. Forecast demands (declining) appear reasonable and consistent with energy efficiency improvements commonly seen in revamped and new high rise buildings.	Yes
Market benefits considered	Consider whether each credible option could deliver certain classes of market benefits.	Market benefits not included in the analysis are: — Changes in voluntary load curtailment: Not mentioned in FPAR, but appears unviable given that the minimum non-network option is 6 MVA. — Changes in the capacity of embedded generators: Not mentioned in FPAR,	Yes

ITEM	REQUIREMENT	ASSESSMENT	MET?
		but appears unviable given that the minimum non-network option is 6 MVA. — Change in electrical losses: These were noted, but not included in the analysis. Given the short distance and large cables being implemented, it is unlikely that the change in electrical losses is a material cost driver for the project. — Option value of the decommissioned sites: Ausgrid confirms that the sites are to be retained.	
Values assigned to market benefits	Use reasonable values	Value assigned to VCR is discussed in section 2.3 and found to be reasonable. Values assigned to safety and environmental benefits appear high and have not been justified. Substituting lower values does not impact on the preferred option but affects the optimal timing when assessed as highest net economic benefit (see section 4.4 for details).	No
Costs	The RIT-D requires in clause 5.17.1(c): (6) a quantification of each applicable cost for each credible option, including a breakdown of operating and capital expenditure; (7) a detailed description of the methodologies used in quantifying each class of cost and market benefit; (8) where relevant, the reasons why the RIT-D proponent has determined that a class or classes of market benefits or costs do not apply to a credible option; It also requires whether the following classes of costs would be associated with each credible option and, if so, quantify the: (i) financial costs incurred in constructing or providing the credible option; (ii) operating and maintenance costs over the operating life of the credible option; (iii) cost of complying with laws, regulations and applicable administrative requirements in relation	Costs for capital and operating (maintenance) are included. Ausgrid did not include: — a detailed description of the methodologies used in quantifying safety and environmental benefits — why the RIT-D proponent has determined that market benefits relating to losses, changes in embedded generation are not included in the analysis. These omissions are not expected to materially impact on the analysis. Costs for the decommissioning of the aged assets at DS and CE are included in the CBA model but not in the Project Timing model. This was not found to be material.	No

ITEM	REQUIREMENT	ASSESSMENT	MET?
	to the construction and operation of the credible option; and (iv) any other financial costs determined to be relevant by the *AER*.		
Cost benefit analysis	The RIT-D requires: (2) not require a level of analysis that is disproportionate to the scale and likely impact of each of the credible options being considered (3) be capable of being applied in a predictable, transparent and consistent manner (8) that any market benefit or cost which cannot be measured as a market benefit or cost to persons in their capacity as Generators, Distribution Network Service Providers, Transmission Network Service Providers or consumers of electricity must not be included in any analysis under the regulatory investment test for distribution (9) the results of a net present value analysis of each credible option and accompanying explanatory statements regarding the results (10) the identification of the proposed preferred option. Clause 5.17.1(c)(9) requires that the RIT-D specify: (i) the method or methods permitted for estimating the magnitude of the different classes of market benefits; (ii) the method or methods permitted for estimating the magnitude of the different classes of costs; (iii) the appropriate method and value for specific inputs, where relevant, for determining the discount rate or rates to be applied; (iv) that a sensitivity analysis is required for modelling the cost-benefit analysis (v) that the credible option that maximises the present value of net economic benefit to all those who produce, consume or transport electricity in the National Electricity Market may, in some circumstances, be a negative net economic benefit (that is, a net economic cost) where the identified need is for reliability corrective action.	A CBA has been undertaken to determine the preferred option. The analysis appropriately covers reliability, safety, environmental and maintenance cost differences. A sensitivity analysis has been undertaken, by changing one key input at a time for high, low and expected values. A more extensive examination of inputs indicates that they will not materially impact the analysis. The FPAR includes discussion on the selection of discount rate used in the analysis, and the selection of the preferred option. The FPAR does NOT include the method adopted for estimating the magnitude of the market benefits for safety, environmental or changed maintenance costs. Additional information was provided by Ausgrid that showed that these omissions do not materially impact on the analysis.	Yes

3.3 CONCLUSION

The FPAR meets the requirements of the RIT-D except for:

- The benefits assigned for safety and environmental appear inappropriate.
- The preferred timing was not based on the highest net economic benefit.

Substituting lower benefit values does not impact on the preferred option but may impact on the optimal timing of the works. These matters are explored in more detail in the sensitivity testing (see section 4).

4 SENSITIVITY TESTING

Ausgrid assessed the timing and NPV of the Sydney CBD project using two models:

— the Project Timing model was used to determine the project timing by calculating the date where the annual benefits from the project exceed the annualised cost of the project.

— the Cost Benefit Analysis model use the timing determined from the Project Timing model and calculates the net present value of the options as well as undertaking scenario and sensitivity analysis.

To validate the choice of preferred option and the optimal timing, WSP reviewed the Ausgrid models and undertook further sensitivity and scenario modelling, WSP completed the following assessments:

— reviewed the key parameters and costs used in the project assessment

— used the Project Timing model to assess sensitivity to a number of factors, in particular, the VCR and corrective maintenance costs. Ausgrid assessed the timing for CE and DS separately, and accepted the later of the two dates.

— modified the CBA model to determine the year of the optimal project NPV based on various VCR, Corrective Maintenance and project date assumptions.

Ausgrid assessed the timing of the two substations individually, using the Project Timing model, and selected the later of the two results as the preferred year for commissioning. However, as the work is closely linked, WSP considers that both substations should be considered as a single project with the total benefits and costs used to identify the timing. This is consistent with how the project was assessed in the CBA model and avoids Issues seen in the Ausgrid approach such as arbitrarily splitting capex between the two stations. WSP adjusted the Project Timing model to achieve this objective.

The following sections outline the results.

4.1 ASSESSMENT OF KEY PARAMETERS

4.1.1 COSTS

The Cost build up provided was very high level but the unit costs provided did not appear to be unrealistic based on WSP experience with cable installation projects.

We note that the cost can be tested using sensitivity analysis to determine if the capital cost is an important driver in project timing. The work done by Ausgrid demonstrates a +/- 2 year change based on capital cost alone.

WSP notes that the decommissioning costs of the project were not included in the Project Timing model, but were included in the CBA model. WSP considers that these are related project costs and therefore they should be included in the timing assessment. The costs were allocated to each project as described in the cost build up sheet provided by Ausgrid. The inclusion of the decommission costs increased the capex by 8.4%.

4.1.2 BENEFITS

The CBA used in the FPAR considered benefits for:

— Reliability of supply

— Corrective maintenance

— Safety

— Environmental impacts.

Each of these impacts is dependent on the value assigned and the calculation methodology. These are discussed and assessed below. The outcome of the revised costs is discussed in sections 4.2 and 4.3.

RELIABILITY OF SUPPLY

The expected unserved energy (EUSE) was calculated using a PSSE network model and Python scripting language to calculate the EUSE in multiple scenarios. The model was not reviewed by WSP, however, the methodology used was discussed with Ausgrid and the input assumptions were reviewed. The methodology was found to be consistent with common industry practice. It was based on a probability weighted amount of energy that would be unserved in certain network configurations for specific events. The inputs to the model were not found to be unreasonable.

The reasonableness of VCR is discussed in section 2.

CORRECTIVE MAINTENANCE

The costs that were identified as corrective maintenance by Ausgrid are actually the expected cost of asset failure for the 11kV switchgear, transformers and reactors. This is common industry practice and not considered to be inappropriate.

11kV Switchgear

Ausgrid uses a conditional probability based on a Weibull distribution. This is common industry practice. The shape and scale factors applied did not appear unreasonable. However, the method of application of probability to determine expected cost outcomes appeared to be overstated, as discussed in the following paragraphs.

The calculation method of summing the probability of failure of each separate CB means that the total probability of failure can exceed one. This appears appropriate as each of the CBs can fail independently, hence it increases the probability of a failure. When the total probability of failure is then multiplied by the cost of replacement, the total cost can exceed the maximum cost of switchboard replacement. In practice, should one or more CBs fail and result in the need to replace the switchboard, the costs would be capped at the replacement cost, regardless of how many CBs fail. To account for this, WSP capped the maximum consequence to the replacement of the full switchboard.

The FPAR outlines three contingency options for the case where the Compound Insulated Switchboard (CIS) at Dalley St fails. The first option is to transfer load to existing spare switchgear in the capacitor room with zero cost, the second is to transfer load to adjacent switchboards with a cost of $306k and the third is to replace the switchboard with a cost of $1.5m. Additionally, Ausgrid is currently in the process of transferring approximately two thirds of the load from Dalley St to City North and this will be complete by 2020 (FPAR page 12). At this date, there should be sufficient capacity on the AIS switchgear to enable the CIS switchgear to be removed from service, hence the cost of maintenance/replacement will be reduced to zero from 2020.

The costs provided by Ausgrid for the Dalley St CIS were hard coded in the spreadsheet. WSP assessed the costs by applying a Weibull curve to determine the probability of failure with the cost of failure being $306k to transfer load to the spare switchgear which is noted to be currently available.. We also considered there should be significantly reduced risk once the load has been transferred away from Dalley St. Our analysis produce results that were not materially different to the costs provided by Ausgrid and therefore we accepted Ausgrid's cost build up.

Other assets

Other assets that were included in the costs build up provided by Ausgrid were:

— 132kV switchgear

— Reactors

— Power transformers

— Feeders

WSP did not identify any issues with the costs associated with the 132kV switchgear or reactors, however, we note that a normal distribution was applied rather than a Weibull distribution. The choice of a different distribution was not explained, but a normal distribution is used by the AER in the repex model, so does not appear inappropriate.

The calculation of the probability of failure for transformers and feeders was not provided to WSP. However, the values do not appear inappropriate and the resultant costs were not considered material with respect to the costs calculated for 11kV switchgear and expected unserved energy.

SAFETY

The probability of a safety incident was calculated based on a Decision Tree style analysis of the probability of each possible outcome occurring. The consequence of each outcome, as shown in Table 4.1, was weighted by the probability of it occurring and all possibilities were summed together to calculate the final probability weighted cost. The total cost was then multiplied by the probability of a failure occurring based on a Weibull distribution and trended forward until the maximum weighted cost, or 100% chance of asset failure, occurring in the final year of the analysis period. This approach did not appear unreasonable.

However, the consequence costs used by Ausgrid shown in Table 4.1 appear to be high. This is considered in two parts by WSP, the cost of safety impacts and the likely number of personnel impacted:

— An economic study by Transport for New South Wales found that the economic cost of a fatality is likely to be between $2.5m and $7.8M.[7]

— DNSPs usually mitigate safety risk through protective clothing and equipment and operational controls. In WSP's experience there is likely to be no more than two personnel present during racking of the circuit breakers and unlikely to be more than 6 people present for maintenance task.

Using the assumptions in the two dot points above, a severe consequence may have a value of $46.8M. This is significantly lower than the severe consequence applied by Ausgrid of $242M.

However, due to the low probability of these events occurring, the costs calculated are not material in comparison to other cost inputs for this assessment so they were not changed by WSP, but were tested through sensitivity analysis.

Although the Dalley St CIS is expected to be removed from service in 2020, WSP took a conservative view and included the safety cost for the entire analysis period. The same safety costs were applied to both substations.

Table 4.1 Safety consequence costs

CONSEQUENCE	AUSGRID CONSEQUENCE
No consequence	$ 0
Minor	$ 2,236,068
Moderate	$ 22,360,680
Major	$ 70,710,678
Severe	$ 242,192,286

ENVIRONMENT

The approach used for City East was based on an estimated clean-up cost of $100k plus a penalty of $1M. WSP considered that this is a realistic approach as it is based on penalties set out in the Protection of Environment Operations Act and a reasonable estimate of remediation costs. The cost was increased annually in proportion with the total asset corrective maintenance costs. However, assets within a zone substation should be properly bunded to prevent oil pollution and the costs identified were only related to cables. Hence, WSP recalculated the cost increase based on the annual increase in feeder maintenance to reflect the likely increase in oil leaks.

7 Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives, TfNSW, 2018

The cost for Dalley Street was based on its contribution to total oil leaks by cables by volume. This amount was multiplied by a total environmental cost of $22.4M to derive an initial cost of these cables of $156k. The initial cost was scaled up in subsequent years based on the percentage annual increase of total corrective maintenance with a value of $650k in the last year of the analysis period. This implies that the total environmental cost to Ausgrid for all cables is $146M in the last year of the analysis ($650k in year 30 divided by 0.7%), which appears high.

WSP disagreed with this approach as it resulted in environmental costs contributing 32% to the total benefits, which appeared unrealistic in the absence of further evidence. WSP substituted in the same approach as used by Ausgrid for City East.

WSP notes it would be preferable to use actual historical maintenance costs rather than these assumptions. Ausgrid noted in the information provided to WSP that there is maintenance incurred each year and there have not been any fines for environmental issues.

WSP REVISED COSTS

Based on our analysis of the costs, WSP made the following adjustments to the CBA model:

— The benefits assigned to 11kV switchgear were adjusted to cap the maximum cost of failure to cost of a complete switchboard replacement.

— The rate of increase of environmental costs at City East was calculated based on the annual increase of feeder corrective maintenance, which was considered the most closely related asset that would drive these costs.

— The environmental cost for Dalley Street was recalculated on the same basis as used for City East, that is a clean-up cost of $100k plus a penalty of $1M and a probability of occurrence of 2%, escalated based on increases in feeder corrective maintenance costs.

The cost adjustments were applied in Ausgrid's models with the results set out in sections 4.2 and 4.3.

4.2 SCENARIO ANALYSIS

The preferred timing of the project was assessed using three approaches:

1. The revised costs were substituted back into the timing spreadsheet to assess the revised preferred timing for the project.
2. The VCR was adjusted to assess the sensitivity of the timing of the project to the VCR.
3. A NPV analysis was performed varying Corrective Maintenance, VCR and both.

The impact of corrective maintenance costs (mostly due to 11kV switchgear at zone substation CE) was tested as this makes the largest single contributor to the benefits stream.

4.2.1 REVISED COSTS

The following Scenarios were tested using the project timing model. The scenarios are the three economic scenarios set out in the FPAR that assess low, expected and high estimates for unserved energy, capital costs, discount rates and VCR.

Table 4.2: Scenarios tested

SENSITIVITY	SCENARIO		
	LOW	EXPECTED	HIGH
Ausgrid benefits	2031	2022	2018
Ausgrid benefits, updated Capex	2032	2023	2018
Updated Capex excluding Safety and Enviro risk benefits	2035	2024	2018
WSP calculated benefits and capex	2034	2024	2018

As would be expected, the Low economic scenario demonstrated that the project could be deferred a number of years. The High scenario always showed that the project was best to be implemented immediately. The Expected scenario was consistent with the preferred timing of the project typically between 2022 and 2024 which aligns with Ausgrid's preferred date.

4.2.2 VCR SENSITIVITY ANALYSIS

The preferred timing of the project was assessed for different VCR values, using Ausgrid's Timing model. The Expected Economic Scenario, as set out in the FPAR, was used in each case.

1. Using the benefits provided by Ausgrid

   The overall timing for the project ranged from 2024 at a VCR of $90/kWh to 2022 with a VCR of $190/kWh. These results are not significantly different to the proposed preferred timing of 2025.

2. Using the benefits provided by Ausgrid with updated Capex

   The additional capex deferred the preferred timing by a year: overall timing for the project ranged from 2025 at a VCR of $90/kWh to 2022 with a VCR of $190/kWh. These results are not significantly different to the proposed preferred timing of 2025.

3. Using the revised benefits and capex developed by WSP

   The additional capex and reduced benefits deferred the preferred timing by three years: overall timing for the project ranged from 2026 at a VCR of $90/kWh to 2024 with a VCR of $190/kWh. These results are not significantly different to the proposed preferred timing of 2025.

These scenarios show that the preferred timing of the project is reasonably stable with respect to the value of the VCR applied. The overall preferred timing falls within the range of 2024 to 2026.

The optimal date for each VCR for each of the three cases above are shown in Table 4.3.

Table 4.3 Sensitivity of preferred timing to VCR under different benefit assumptions

VCR ($/KWH)	BENEFITS ASSUMPTIONS		
	CASE 1	CASE 2	CASE 3
90	2024	2025	2026
100	2023	2024	2026
110	2023	2024	2025
120	2023	2024	2025
130	2023	2024	2025
140	2023	2023	2024
150	2022	2023	2024
160	2022	2023	2024
170	2022	2023	2024
180	2022	2023	2024
190	2022	2022	2024

4.3 OPTIMAL NPV ANALYSIS

Ausgrid's Project Timing model compares the annualised cost against the benefits to determine the appropriate date when the work should be completed. The calculated date, 2025, represents the timing of the works to minimise net costs to consumers. As such, it is not based on a NPV calculation that maximises net economic value, which approach would be more consistent with the RIT-D requirements for selecting the preferred option. WSP was uncertain whether Ausgrid's approach would yield a similar outcome to an approach based on an optimal NPV analysis.

Additionally, WSP wanted to test the sensitivity to key inputs and this was not readily done using the Project Timing Model.

To resolve these issues, WSP used Ausgrid's CBA model to assess the year of the optimal NPV. The model was modified to enable variation of the preferred commissioning date, VCR and Corrective Maintenance assumptions and cashflows of the benefits. The following modifications made were:

— the analysis period was extended to 60 years. When assessing changes in project timing using the CBA model, the analysis period of 20 years resulted in benefits being excluded when the commissioning date was delayed. Extending the time period enabled these benefits to be captured and ensure a consistent analysis for all timing assumptions. The impact is a higher NPV as more benefits are captured, however, our interest in this analysis is in the changes to the NPV rather than the absolute value.

— the corrective maintenance and expected energy at risk were trended forward using a linear trend to reflect the deterioration of the assets and increased costs incurred

— environmental and safety costs were projected forward with a flat trend, i.e. the value calculated for the last year in the cost build up was applied to all subsequent years

— formulas were added to adjust the cashflows based on the specified commissioning year

— the benefits in the model were updated to reflect WSP's analysis of the cost build-up data.

The project NPV was assessed using the Expected Economic Scenario.

We note that the project is assumed to take 5 years for construction and this assumption was maintained. Hence, the earliest year for commissioning was found to be 2024.

4.3.1 CORRECTIVE MAINTENANCE BENEFITS SENSITIVITY ANALYSIS

WSP undertook sensitivity analysis for the Corrective Maintenance costs while considering the impact on the overall preferred timing of the project. The corrective maintenance at zone substation City East was found to be the most material contribution to the benefits other than energy at risk. The value was varied between 0% and 200% of the proposed value.

Table 4.4 shows that as the benefits from corrective maintenance increase, the optimal year for commissioning the project is brought forward. The expected benefits result in an optimal year of 2026. It also demonstrates that the preferred timing is not materially sensitive to reasonable variations in corrective maintenance. Although the optimal NPV occurs in 2026, the difference to the NPV in 2025 (Ausgrid's preferred date) is not material.

Table 4.4: NPV per year for varying assumptions on corrective maintenance (based on revised costs)

	2024	2025	2026	2027	2028	2029	2030
50%	67.4	68.2	68.7	68.9	68.9	68.5	67.8
60%	69.3	70.0	70.5	70.6	70.5	70.0	69.2
70%	71.3	71.9	72.2	72.3	72.1	71.5	70.7
80%	73.2	73.7	74.0	74.0	73.7	73.0	72.1
90%	75.1	75.6	75.8	75.7	75.3	74.6	73.6
100%	77.1	77.4	77.5	77.4	76.9	76.1	75.0
110%	79.0	79.3	79.3	79.0	78.5	77.6	76.5
120%	80.9	81.1	81.1	80.7	80.1	79.2	77.9
130%	82.8	83.0	82.8	82.4	81.7	80.7	79.4
140%	84.8	84.8	84.6	84.1	83.3	82.2	80.8
150%	86.7	86.7	86.4	85.8	84.9	83.7	82.3

4.3.2 RELIABILITY BENEFITS SENSITIVITY ANALYSIS

Sensitivity was tested by varying the VCR. The analysis showed that, as expected, as the VCR increased the year with the highest NPV was brought forward.

The analysis assessed the VCR from $90/kWh to $190/kWh and from 2024 (the earliest possible year) to 2037. This reflected the range of VCRs discussed in Section 2 and starts with the earliest possible commissioning year.

Table 4.5 shows the results of the analysis, demonstrating the optimal year is 2026. It also demonstrates only slight sensitivity of the preferred timing to the VCR.

Table 4.5: NPV for varying assumption on VCR (based on revised costs)

	2024	2025	2026	2027	2028	2029	2030
90	36.8	37.6	38.1	38.5	38.6	38.5	38.2
100	41.8	42.5	43.0	43.3	43.4	43.2	42.8
110	46.9	47.5	48.0	48.2	48.2	47.9	47.4
120	51.9	52.5	52.9	53.0	52.9	52.6	52.0
130	56.9	57.5	57.8	57.9	57.7	57.3	56.6
140	62.0	62.5	62.8	62.8	62.5	62.0	61.2
150	67.0	67.5	67.7	67.6	67.3	66.7	65.8
160	72.0	72.4	72.6	72.5	72.1	71.4	70.4
170	77.1	77.4	77.5	77.4	76.9	76.1	75.0
180	82.1	82.4	82.5	82.2	81.7	80.8	79.6
190	87.1	87.4	87.4	87.1	86.5	85.5	84.2

4.3.3 CORRECTIVE MAINTENANCE AND RELIABILITY BENEFITS SENSITIVITY ANALYSIS

WSP undertook an assessment of the optimal timing for the project by varying both the corrective maintenance at City East and the VCR. Table 4.6 shows the year in which the NPV is calculated to be the highest for the corresponding VCR values ($/kWh) and corrective maintenance values at City East. All other values held constant.

The analysis shows that the most frequently occurring year is 2026 for all variations and it demonstrates small sensitivity to changes in these variables.

Table 4.6: Optimal timing of project for varying values of VCR (columns) and corrective maintenance (rows)

	90	100	110	120	130	140	150	160	170	180	190
50%	2030	2030	2029	2029	2028	2028	2028	2027	2027	2027	2027
60%	2030	2029	2029	2028	2028	2028	2027	2027	2027	2027	2027
70%	2029	2029	2028	2028	2028	2027	2027	2027	2027	2026	2026
80%	2029	2028	2028	2028	2027	2027	2027	2027	2026	2026	2026
90%	2028	2028	2028	2027	2027	2027	2027	2026	2026	2026	2026
100%	2028	2028	2027	2027	2027	2027	2026	2026	2026	2026	2026
110%	2028	2027	2027	2027	2026	2026	2026	2026	2026	2025	2025
120%	2027	2027	2027	2026	2026	2026	2026	2026	2025	2025	2025
130%	2027	2027	2026	2026	2026	2026	2025	2025	2025	2025	2025
140%	2027	2026	2026	2026	2026	2025	2025	2025	2025	2025	2024
150%	2026	2026	2026	2025	2025	2025	2025	2025	2024	2024	2024

(1) Based on revised costs, refer section 4.1

4.4 CONCLUSION

Based on the analysis of the Project Timing and CBA models, WSP considers that:

— the preferred option to undertake construction of new underground cable feeders that will transfer 90 MVA of load from zone substations CE and DS to Belmore Park is not impacted by variations to key inputs, including to reasonable choices in the value of VCR.

— WSP found the preferred timing based on the Project Timing model, which determined the year when annual benefits of replacement exceed the annualised cost of the project, to occur between 2024 and 2026.

— WSP found the preferred timing for the project based on the highest NPV calculated using the CBA model to generally fall between 2025 and 2027, with 2026 being the preferred year when applying the expected values of costs and benefits.

The analysis shows that the optimal timing of the project is not materially dependent on assumptions made about capital costs, safety benefits, maintenance cost benefits and VCR. It also demonstrates that there is potential to defer the project by one or two years, however, the difference in NPV is not material and therefore a commissioning year of 2025 is not considered inappropriate.