Ensuring reliability requirements in the Lower North Shore area

NOTICE ON SCREENING FOR NON-NETWORK OPTIONS REPORT

MAY 2018

Ausgrid

Addressing reliability requirements in the Lower North Shore area

Notice on screening for non-network options – May 2018

Title of Contents

Disclaimer

Ausgrid is registered as both a Distribution Network Service Provider and a Transmission Network Service Provider. This notice on screening for non-network options has been prepared and published by Ausgrid under clause 5.17 of the National Electricity Rules to notify Registered Participants and Interested Parties of the results of the regulatory investment test for distribution and should only be used for those purposes.

This document does not purport to contain all of the information that a prospective investor or participant or potential participant in the National Electricity Market, or any other person or interested parties may require. In preparing this document it is not possible nor is it intended for Ausgrid to have regard to the investment objectives, financial situation and particular needs of each person who reads or uses this document.

This document, and the information it contains, may change as new information becomes available or if circumstances change. Anyone proposing to rely on or use the information in this document should independently verify and check the accuracy, completeness, reliability and suitability of that information for their own purposes.

Accordingly, Ausgrid makes no representations or warranty as to the accuracy, reliability, completeness or suitability for particular purposes of the information in this document. Persons reading or utilising this document acknowledge that Ausgrid and their employees, agents and consultants shall have no liability (including liability to any person by reason of negligence or negligent misstatement) for any statements, opinions, information or matters (expressed or implied) arising out of, contained in or derived from, or for any omissions from, the information contained in this document, except insofar as liability arising under New South Wales and Commonwealth legislation.

1 Introduction

The underground electricity distribution lines (‘feeders’) supplying the Castle Cove and Mosman zone substations were commissioned in the 1970s, and are now reaching, or past, the end of their technical lives. These feeders utilise self-contained fluid filled cables, which are now considered an obsolete and dated technology. They are becoming less reliable and expose Ausgrid’s customers in the Lower North Shore network area to a level of reliability that exceeds the allowance applicable to Ausgrid under current standards if nothing is done.

Ausgrid identified the need to replace the feeders supplying the Mosman substation in 2017 and identified a preferred solution to mitigating the identified risks.

Since 2017, Ausgrid has undertaken a range of community engagement activities seeking feedback on the preferred replacement option identified in 2013. These activities included meeting with Willoughby City Council, North Sydney Council and Mosman Council, as well as having representatives from the Ausgrid project team speak to many businesses and visiting residents in these council areas. This consultation included visiting and distributing project information to residents along the impacted streets. Feedback received was very helpful and resulted in a number of refinements to the preferred solution. Ausgrid wishes to thank all those consulted with for their time and suggestions.

Rule changes to the National Electricity Rules (NER) in July 2017 have meant that the replacement plans for ageing feeders are now subject to the RIT-D. Accordingly, Ausgrid has initiated this RIT-D for replacing ageing feeders supplying the Mosman zone substation in order to investigate and consult on options to ensure Ausgrid is able to satisfy the reliability and performance standards that it is obliged to meet.

A full discussion of asset conditions and the identified need can be found in the Draft Project Assessment Report (DPAR) for addressing reliability requirements in the Mosman zone substation.

This notice has been prepared under cl. 5.17.4(d) of the NER and summarises Ausgrid’s determination that no non-network option is, or forms a significant part of, any potential credible option for this RIT-D. In particular, it sets out the reasons for Ausgrid’s determination, including the methodologies and assumptions used.

2 Forecast load and capacity

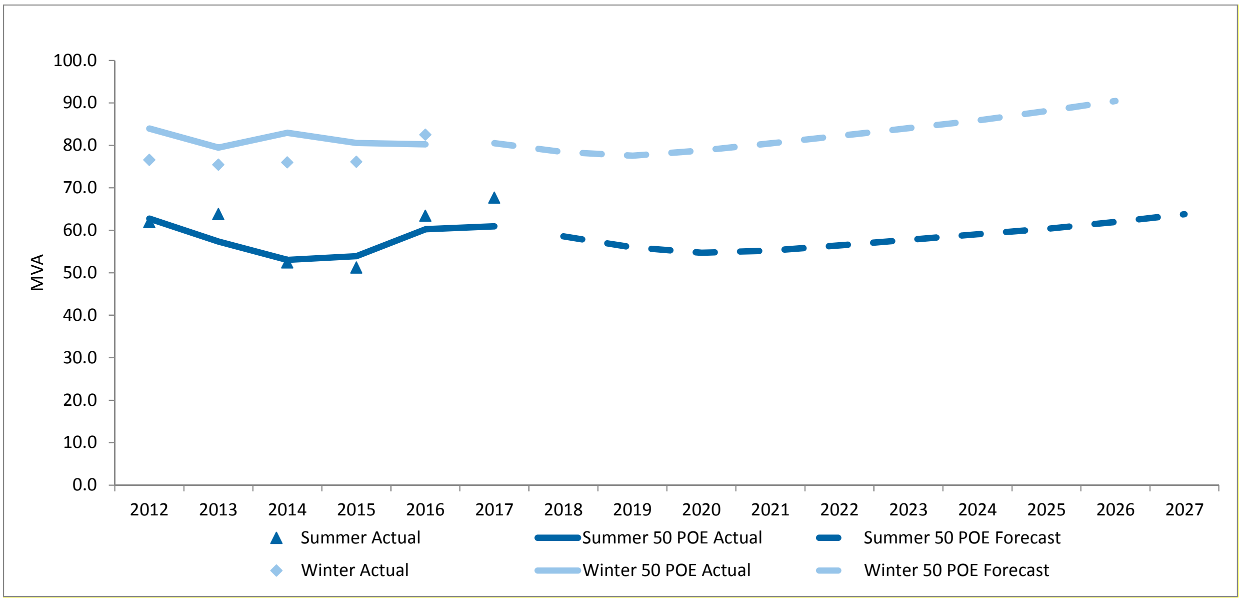
2.1 Load forecast

Figure 1 below shows the historical actual demand, the 50% Probability of Exceedance level (50 POE) weather corrected historical actual demand and the 50 POE forecast demand for both winter and summer for Mosman zone substation.

The Mosman zone substation has a total capacity of 152.4 MVA and a firm capacity of 82.5 MVA. In winter 2016, the maximum demand on zone substation was 82.5 MVA at 7:00pm AEDT on 27 June 2016. The weather corrected demand at the 50 POE level was 80.2 MVA. The power factor at the time of winter maximum demand was 0.99.

Maximum demand has typically occurred in winter in past years. In the summer season, the maximum demand typically occurs between 1:00pm and 4:15pm AEDT. The 50 POE forecast 7 year compound annual growth rate (CAGR) to 2023 for maximum demand is 0.35% for winter and -0.45% for summer.

Figure 1 – Demand forecast at Mosman zone substation



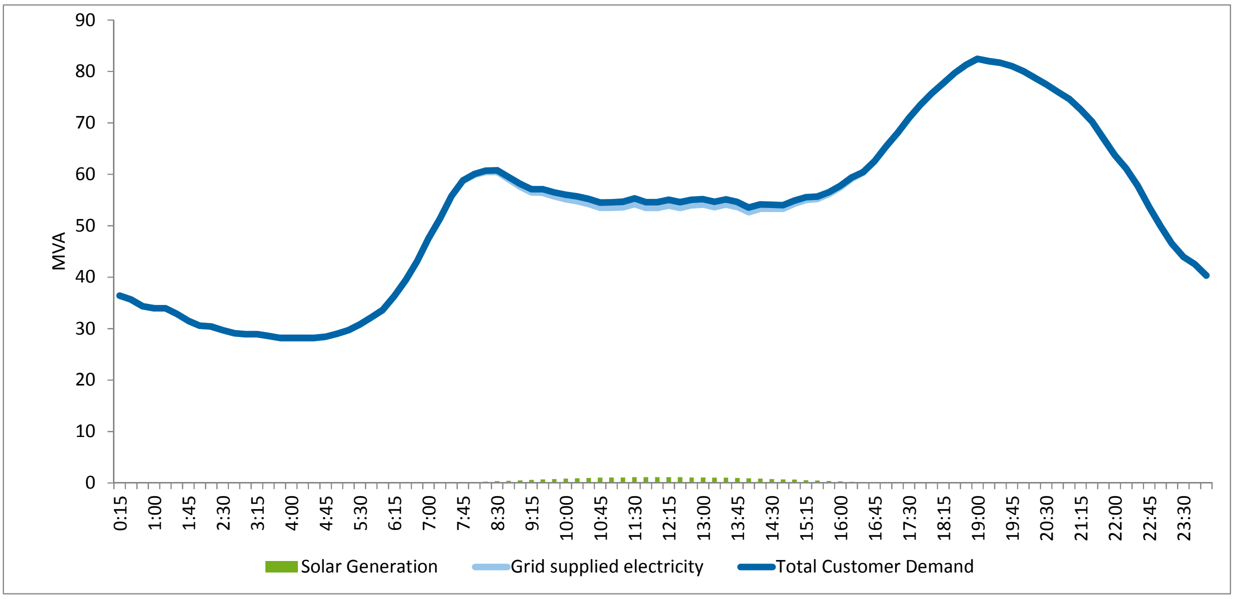
2.2 Pattern of use

Winter peak electricity demand at Mosman zone substation occurs on coldest days driven predominantly by residential loads.

Over the past 7 years, and where peak annual demand occurs in winter, the time of peak has typically occurred between 6:00pm and 7:30pm AEDT. As noted above, the most recent winter maximum demand occurred at 7:00pm AEDT.

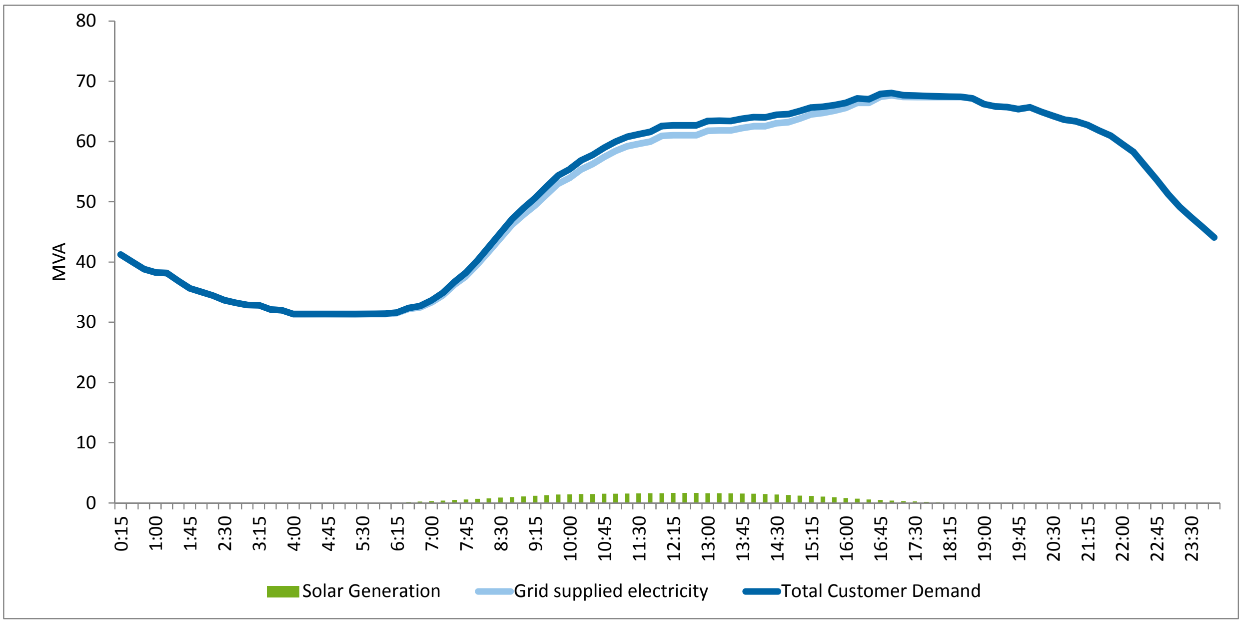
There is a total capacity of about 2.5 MW of solar PV connected to the zone substation. At the peak time on 27 June 2016, these PV systems supplied about 0 MW of the customer load. Figure 2 below shows the load profile for the 27 June 2016 maximum demand day including the contribution from customer installed solar power systems.

Figure 2 – Winter maximum demand profile at Mosman zone substation (27 June 2016)



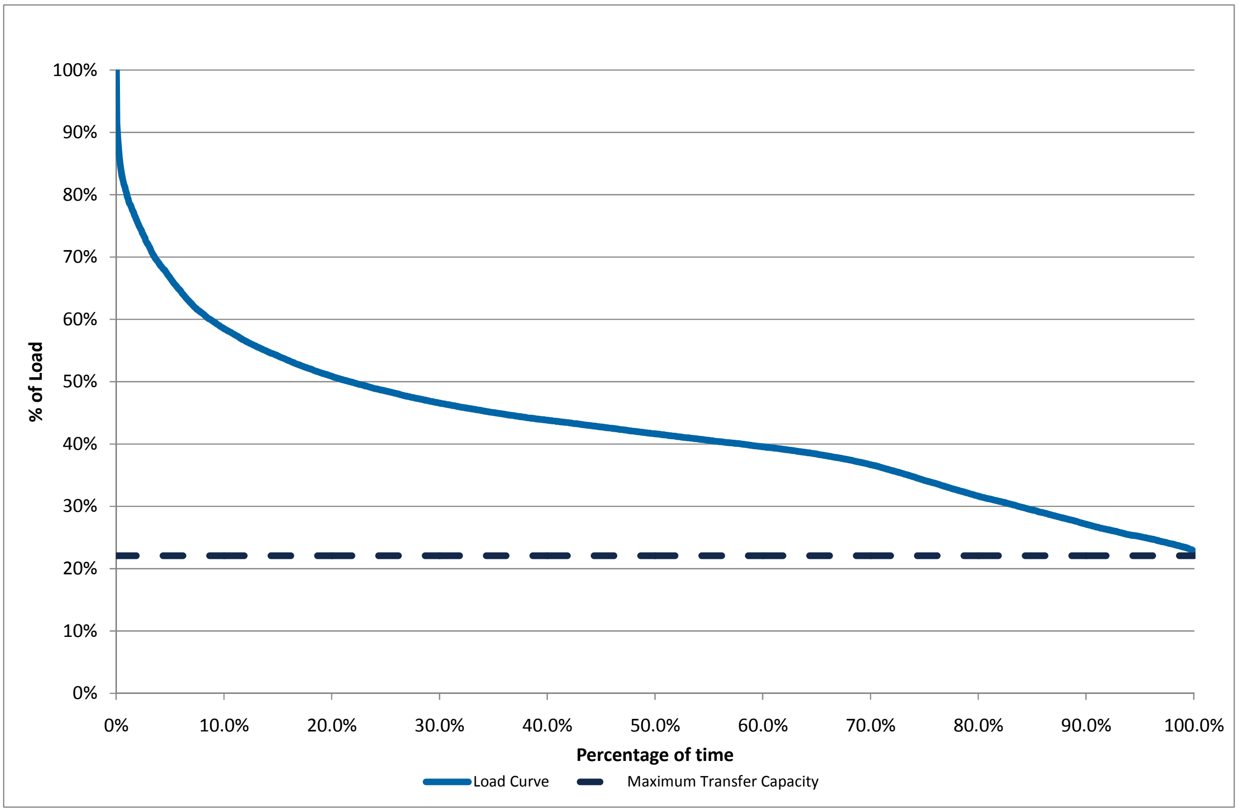
Summer peak electricity demand at Mosman zone substation typically occurs in the late afternoon. Over the past 7 years, the time of summer peak has typically occurred between 5:00 pm and 8:45pm AEST. Figure 3 below shows the load profile for the 11 February 2017 peak demand day including the contribution from customer installed solar power systems.

Figure 3 – Summer maximum demand profile at Mosman zone substation (11 February 2017)



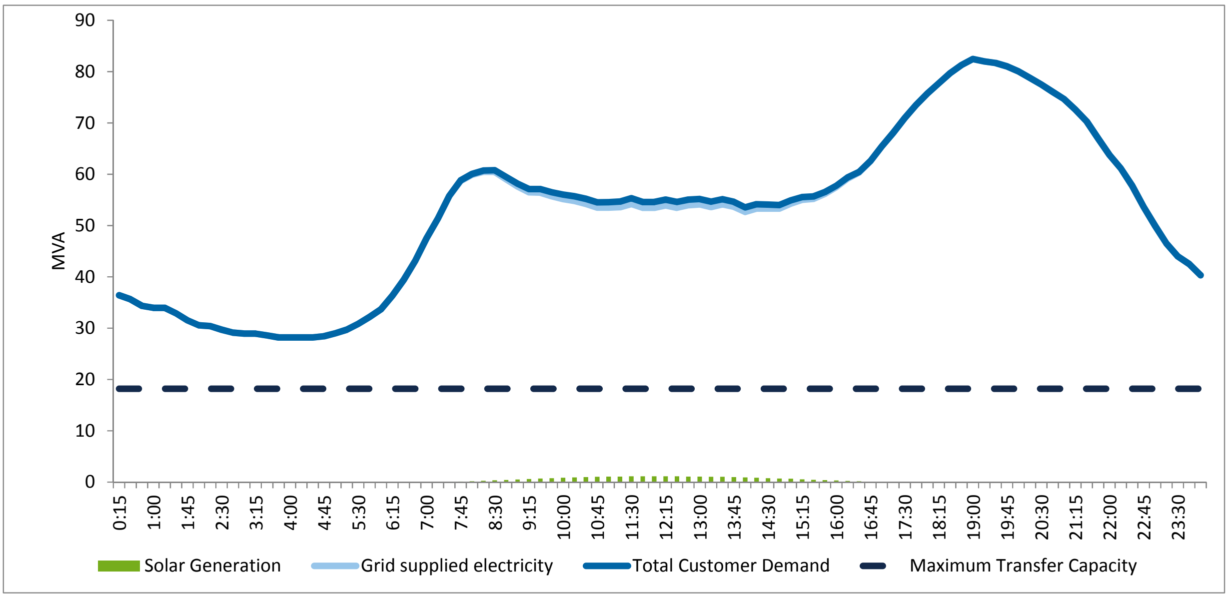
The Mosman zone substation has a current load transfer capacity of 18.2 MVA or about 22.1% of the most recent actual maximum winter demand and 26.9% of most recent actual maximum summer demand. Based upon the data period from May 2016 to April 2017, electricity demand for Mosman zone substation exceeds the transfer capacity for all hours of the year. The load duration curve for the period from May 2016 to April 2017, noting the transfer capacity, is shown below in Figure 4.

Figure 4 – Mosman zone Substation Load Duration Curve (May 2016 to April 2017)



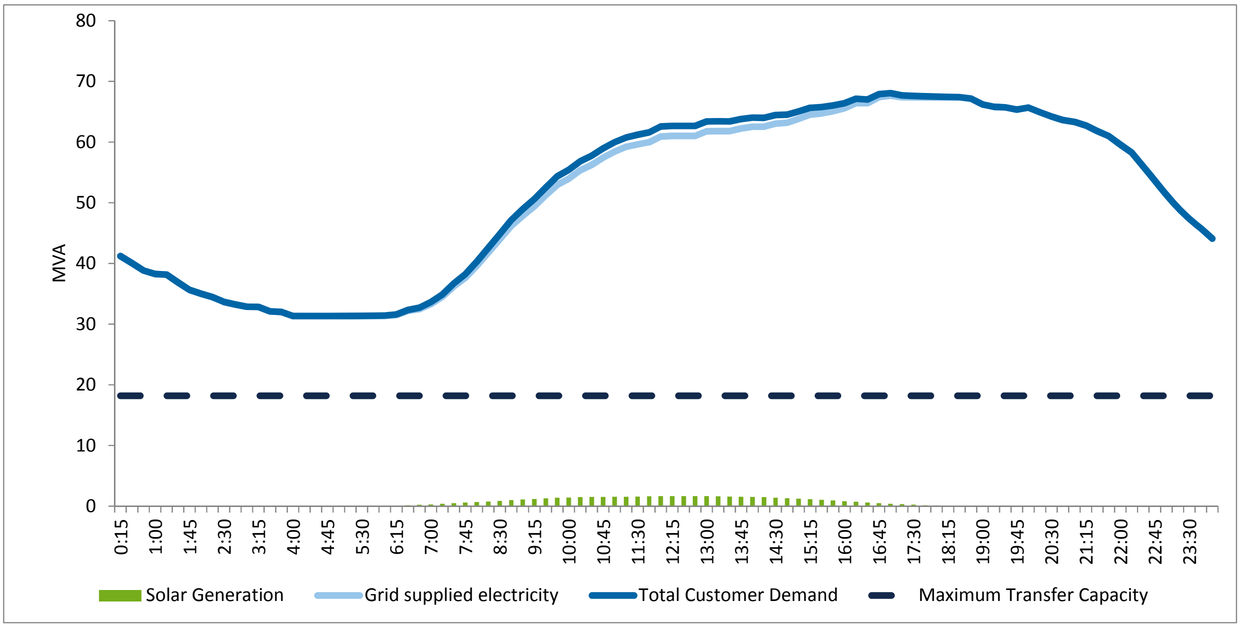
In the event of a network outage on a maximum winter peak demand day, after use of the maximum transfer capacity in an emergency switching of the network, there is a shortfall of network supply from 6:00pm to 7:30pm. The maximum shortfall in network supply on 27 June 2016 would have been 64.3 MVA at peak time. See Figure 5 below.

Figure 5 – Winter maximum demand profile at Mosman zone substation with maximum load transfer



Similarly for a summer peak demand day, the shortfall in network supply would be from 5:00pm to 8:45pm. The maximum shortfall in network supply on 11 February 2017 would have been 49.5 MVA at peak time. See Figure 6 below.

Figure 6 – Summer maximum demand profile at Mosman zone substation with maximum load transfer



2.3 Customer characteristics

Mosman zone substation serves a mixture of residential and non-residential customers with over 36.0% of annual electricity consumption from non-residential customers. A breakdown of the customer characteristics for the 2016/17 period is as follows:

Table 1 – Customer characteristics – Mosman zone

Item	Residential	Small Non-Residential	Large Non-Residential	Total
Number of Customers	30,032	2,604	112	32,748
% of Customers	91.7%	8.0%	0.3%	
Annual Consumption (MWh)	177,597	48,964	51,104	277,665
% of Annual Consumption	64.0%	17.6%	18.4%	
Number of Solar Customers	716	25	5	746
% of Solar Customers	96%	3%	1%	
Average Annual Consumption (MWh per customer)	5.9	19	456	

About 34% of residential customers live in detached homes with an average usage of about 9.8 MWh per year. Households living in apartments, townhouses and flats have an average usage of about 3.9 MWh per year.

2.4 Key assumptions underpinning the identified need

The need to undertake action is predicated on the deteriorating condition of the two existing 132kV underground feeders from the Castle Cove zone substation to the Mosman zone substation and the characteristics of any resultant outages, as well as the fact that maintaining technologies present heightened maintenance and asset failure risks.

This section summarises the key assumption underpinning the identified need for this RIT-D. Appendix C provides additional detail on assumptions used, and methodologies applied, to estimate the costs and market benefits as part of this RIT-D.

The 132kV cable feeders 9Y7 and 9Y9 supply Castle Cove and Mosman Zone Substations from Lindfield STS. The cable section between Castle Cove and Mosman (9Y7/2 and 9Y9/2) is fluid-filled.

The simultaneous outage of feeders 9Y7/2 and 9Y9/2 would take both Castle Cove and Mosman zone substations out of service as there are no 132kV feeder circuit breakers at each substation. A third, normally on stand-by, fluid filled feeder (9P7) from Willoughby to Mosman Zone Substation could be energised to supply Mosman substation by disconnecting bonds on feeders 9Y7/2 and 9Y9/2, and would have to be reversed to restore normal supply.

The concurrent outage of these feeders would result in the loss of supply to Castle Cove and Mosman zone substations. Partial loads would be recovered via 11kV load transfer to nearby zone substations using existing connections after a time delay (switching time). Essentially there is a low, but increasing, probability that a significant portion of the customers in this area will experience a very long blackout. Based Ausgrid's cable failure model, the aggregated expected unserved energy associated with these feeders has been calculated to be approximately 240MWh in the next five years.

Cables 9Y7/2 and 9Y9/2 have experienced moderate fluid leaks over the past 15 years. Based on leakage data, along with an assessment of the environmental sensitivity along the cable route, the 2017 review of fluid filled 132kV cable environmental risk assessed cables 9Y7/2 and 9Y9/2 as contributing 1.63 per cent and 1.12 per cent of the total environmental risk assigned to Ausgrid's fluid filled cable population.

Insulation resistance testing indicates that there may be problems with the outer serving of the cables, which could lead to fluid leaks in the future. Our cable failure model forecasts that the reliability of these cables will deteriorate into the future if they are not replaced.

The cables supply Castle Cove and Mosman Zone Substations in the Lower North Shore area and their integrity are essential to ensure reliable supply for customers in these areas.

Both these substations are considered to serve an enduring need for distributing electricity in the Lower North Shore network area.

2.5 Load transfer capacity and supply restoration

The level of cost expected from any involuntary load shedding is dependent on underlying assumptions relating to the level of redundancy in feeders and the capacity to transfer load to other substations that could supply load currently served by the Castle Cove and Mosman substations.

Current supply arrangements for these zone substations have a degree of redundancy. As noted above, multiple feeders supply each substation and therefore load could be transferred to the two remaining feeders should one of the fluid-filled feeders experience a fault or be out of service. However, outages of multiple feeders supplying each substation would likely lead to some degree of involuntary load shedding. Further, as feeders age, the likelihood of multiple feeder failures increases that in turn is likely to lead to involuntary load shedding.

In addition, while feeder 9P7 is currently on stand-by, it has a limited rating due to the concurrent presence of other 132kV feeders in the same trench.

In the event of multiple failures, there is limited capacity to move load away from the Castle Cove and Mosman substations given network constraints in the Lower North Shore network area. Ausgrid estimates that the capacity to transfer is limited to 18 MVA, which is small relative to the overall demand of around 80 MVA. Consequently, restoration of supply to customers these areas would depend on the time needed to return feeders to service.

Both the degree of redundancy and the ability to transfer load elsewhere have been taken into account by Ausgrid in forecasting expected unserved energy.

The following Table 2 presents additional detail on the supply restoration assumptions and probability of failure assumptions made by Ausgrid.

Table 2 – Supply restoration assumptions

Equipment outage	Action	Outage duration
Fluid filled cable failure	Repair The cable is repaired on site.	7.0 weeks
Fluid filled cable third party damage	Repair The cable is repaired on site. Additional time is typically required to repair third party damage.	5.5 weeks
Fluid filled cable corrective action	Repair One of the following repairs may take place depending on the failure mode: 1. in service repair (65 per cent) 2. out of service repair (35 per cent)	1. In service repair (no outage) 2. 1.06 weeks

3 Proposed preferred network option

Ausgrid has elected to assess three alternative future scenarios – namely:

- Low benefit scenario – Ausgrid has adopted several assumptions that give rise to a lower bound NPV estimate for each credible option, in order to represent a conservative future state of the world with respect to potential market benefits that could be realised under each credible option;
- Baseline scenario – the baseline scenario consists of assumptions that reflect Ausgrid's central set of variable estimates, which, in Ausgrid's opinion, provides the most likely scenario; and
- High benefit scenario – this scenario reflects an optimistic set of assumptions, which have been selected to investigate an upper bound on reasonably expected potential market benefits.

A summary of each scenario and the sets of variable values adopted is presented in the Table 3 below.

Table 3 – Summary of the three scenarios investigated

Variable	Scenario 1 – baseline	Scenario 2 – low benefits	Scenario 3 – high benefits
Demand	POE50	POE90	POE10
VCR	$40/kWh (Derived from the AEMO VCR estimates)	$28/kWh (30 per cent lower than the central, AEMO-derived estimate)	$90/kWh (Consistent with the recent IPART review of transmission reliability standards for this area)
Commercial discount rate	6.13 per cent	8.07 per cent	4.19 per cent

Ausgrid has identified two network options that either replace the existing Castle Cove feeders by installing two new 132kV feeders from the Willoughby STS to Mosman via Cremorne Junction or undertaking a like-for-like replacement of the existing Castle Cove feeders.

Preferred option at this draft stage

This option involves the replacement of the two existing feeders from Castle Cove to Mosman using two new installations at the Willoughby STS. Specifically, this option involves the installation of two new 132kV feeders from Willoughby STS to Mosman zone substation. These new feeders will be routed to Mosman via the proposed Cremorne Junction zone substation site.

The scope of the project includes:

- works at Willoughby STS and Mosman zone substation to facilitate new 132kV feeder connections;
- installation of a dual circuit 132kV feeder approximately 7km in length between Willoughby STS and Mosman zone substation; and
- control and protection communication upgrades at the Willoughby STS and Mosman zone substation to accommodate the new feeders.

The estimated capital cost of this option is approximately $28.9 million. Ausgrid assumes that the necessary construction to install the new feeders would commence in 2018/19 and end in 2021/22. One the new installation is complete, operating costs are expected to be $150,000 per annum (around 0.5 per cent of capital expenditure).

4 Assessment of non-network solutions

4.1 Required demand management characteristics

A viable demand management solution must be capable of reducing the load on Mosman zone substation sufficiently to retain supply to customers over the required time for restoration of supply in the event of an unplanned cable outage. This reduction in supply can be permanent or temporary but must:

- offer support in both summer and winter and other times of the year,
- align with the load profiles after emergency load transfer and
- be cost effective in comparison with the preferred network alternative.

Due to the scale of the shortfall in electricity supply, we consider that a combination of permanent and temporary demand reductions would offer the most plausible scenario for a possible cost effective non-network alternative. Refer to Section 2 for details on the load profiles, demand forecasts, emergency load transfer capacities and customer characteristics.

A detailed assessment of the load profile for Mosman zone substation over the May 2016 to April 2017 period shows that the shortfall in supply after emergency load transfers have been implemented is significant. Refer to Table 4 below for details on the network support requirements for the years from 2020/21 to 2022/23.

Table 4 – Network support required at Mosman zone substation

Year	MW	MWh	Days/year		Hours/year	
			Summer	Winter	Summer	Winter
2020/21	61	106,106	125	123	3,000	2,952
2021/22	62	110,684	125	123	3,000	2,952
2022/23	64	115,508	125	123	3,000	2,952

To be considered a feasible option, any demand management solution must be technically feasible, commercially feasible; and able to be implemented in sufficient time to satisfy the identified need in 2020/21 and/or 2022/23 for deferral of the network investment.

4.2 Demand management value

Ausgrid has assessed potential demand management options to achieve the required demand reduction to make the project deferral technically and economically viable. Table 5 indicates the available funds that can be spent to achieve a 1, 2, 3 year deferral of network option expressed both as an overall cost and on a $/MWh basis.

We have expressed the available funds on an energy basis as the demand management support is principally associated with a shortfall in energy capacity rather than a shortfall in peak demand capacity. These figures are indicative only and any credible demand management solution proposed will be evaluated against the preferred network solution in a full RIT-D evaluation.

Table 5 – Funds available for demand management based on cost benefit analysis

Deferral benefits	Average % total risk reduction per year	Available funds in 2020/21, 2021/22, & 2022/2023	Peak Load Reduction required (MW) per year	Est. MWh reduction required in each year	Available $ per MWh
1 yr deferral	20%	$387,600	12	12,037	$32
2 yr deferral	38%	$474,100	22	27,749	$17
3 yr deferral	47%	$469,300	26	40,993	$11

4.3 Demand management options considered

Ausgrid has considered a number of demand management technologies to determine their commercial and technical feasibility to assist with the identified need at the Mosman zone substation. Each of the demand management technologies considered is summarised below.

4.3.1 Customer power factor correction

While this option is technically feasible and offers permanent reductions sufficient to cover the large number of unmet load hours, there are many customers on a kVA demand tariff supplied from Mosman zone substations. Of the 32,748 customers connected to Mosman zone substation, only 112 are on a kVA demand tariff. Analysis of customer interval data indicates a technical potential of only about 450kVA. Commercial potential is likely to range from 100 to 200 kVA. At a likely cost of about $25-50 per kVA, this solution is likely to be cost effective, but is estimated to contribute less than 1.4% of the requirement.

4.3.2 Customer solar power systems

While this option is technically feasible and offers permanent reductions, solar power systems are not estimated to offer a material reduction in grid supplied demand during the period when there is a shortfall in grid supply.

Analysis of interval data for Mosman zone substation show that solar generation is greater than about 30% of maximum panel capacity for 30% of unmet load hours in winter, 49% of unmet load hours in summer and about 38% of overall unmet load hours. The solar power system will help reduce energy only but not peak demand, because the peak demand in Mosman zone always occurred in the evening both in winter and summer,

At present there are 2.5MW of solar connected to Mosman zone substation. However, the solar system has no impact on peak reduction at Mosman zone because the zone peak occurred in the evening around 7pm. Therefore, an increase in the take-up of new solar power systems has a little impact on the share of unmet load in the area.

4.3.3 Customer energy efficiency

While this option is technically feasible and offers permanent reductions, improvements to customer energy efficiency are not estimated to offer a sufficiently cost efficient alternative, nor potentially a sufficiently material reduction in grid supplied demand during the period when there is a shortfall in grid supply. Assuming modest incentives of 10-15% of customer investment cost could encourage customers to install a greater scale of energy efficiency improvements than would otherwise occur, we estimate an average cost of about $1000-2000 per MWh depending upon the level of additionality and coincidence with the demand shortfall. This solution is not likely to offer a cost competitive alternative.

4.3.4 Demand response (curtailment of load)

Customer curtailment of load is a common and effective technique for deferring network investment where the need is for short time periods and few days but has not been shown to be viable for the extensive hours and consecutive days of network support required for the network issue at Mosman zone substation.

Large customer demand response has historically been priced at $75-150 per kVA for 20-60 hours of dispatch per season while residential air conditioner demand response has been shown to be acceptable to small customers at incentive payment levels of about $150 to $250 per kVA for 20-30 hours of dispatch per season (excluding acquisition costs). Considering the costs of acquisition and requirement for support in two seasons each year, we would estimate the average cost for demand response to be about $2000 to $3000 per MWh for large customer demand response and greater than $5000 per MWh for small customer demand response. At a cost many times the available funds, this solution is not likely to offer a cost competitive alternative.

4.3.5 Dispatchable generation

Dispatchable generation is another common and effective technique for deferring network investment where the need is for short time periods and few days but has not been shown to be viable for the extensive hours and consecutive days of network support required for the network issue at Mosman zone substation.

Large customer dispatchable generation has historically been priced at $50-150 per kVA for 20-60 hours of dispatch per season. Considering the costs of acquisition and requirement for support in two seasons each year, we would estimate the average cost for this form of demand response to be well in excess of the available funds. Furthermore, as this solution commonly sources existing standby diesel generators; environmental compliance issues are likely to constrain the number of available operating hours.

4.3.6 Large customer energy storage

While this option is technically feasible and offers a viable form of demand response, current and near term pricing of commercial scale battery storage solutions are unlikely to result in a material take-up of these systems by large customers. Recent surveys by Ausgrid of medium and large customers on issues related to investments in solar power, battery storage and energy efficiency has shown that these customers expect a return on investment which is not projected to be available for some time.

5 Conclusion

Based on the demand management options considered in Section 4, it is not considered possible that sufficient demand management measures could be feasibly implemented to achieve the required demand reduction to make project deferral technically and economically viable. Consequently, a Non-Network Options Report has not been prepared in accordance with rule 5.17.4(c) of the National Electricity Rules.

Ausgrid