Ensuring reliable supply for the Sydney Airport network area

NOTICE ON SCREENING FOR NON-NETWORK OTIONS

MARCH 2020

Ausgrid Connecting communities, empowering lives

Ensuring reliable supply for the Sydney Airport network area

Notice on screening for non-network options – 6 March 2020

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1 Introduction

Sydney Airport (the airport) is the largest airport in Australia, accounting for around 40% of international passenger movements and 47% of air freight. It facilitates the generation of $38 billion in economic activity, which represents 2.2% of Australian Gross Domestic Product (GDP) and 6.8% of NSW GDP[1]. The airport receives grid supply from Ausgrid's 33kV network via two zone substations: Sydney Airport zone substation (ZS) which supplies the domestic terminal and International Terminal ZS which supplies the international terminal. The International Terminal ZS was commissioned in 2000 and is in good condition.

Sydney Airport ZS supplies the Sydney Airport domestic terminal as well as some of the airport's commercial load through a network owned by the Sydney Airport Corporation Ltd (SACL). This zone substation was commissioned in 1969 and much of the original equipment is still in service. The 33/11kV transformers and 11kV switchgear are owned by SACL whilst the 33kV switchgear is owned by Ausgrid. The 33kV and 11kV switchgear is housed in separate rooms in a common switchroom building owned by SACL. Both the 11kV and 33kV switchgear at Sydney Airport ZS is in poor condition and requires replacement. SACL has initiated 11kV switchgear replacement works at their cost.

The 33kV switchgear equipment is compound insulated and has oil circuit breakers. Compound insulated switchgear has exhibited failures ranging from single equipment failures to multiple equipment failures impacting the operation of an entire substation. Furthermore, the 33kV oil circuit breakers at Sydney Airport ZS were originally commissioned in 1955 and are now an orphan technology with very limited spare parts availability. Ausgrid has conducted a condition and risk assessment of the equipment. In the event of failure, the risk of expected unserved energy from involuntary load shedding is such that it justifies the corrective actions outlined in the Final Project Assessment Report.

Capital expenditure for replacement projects are subject to the Regulatory Investment Test for Distribution (RIT-D). No exemptions listed in the NER clause 5.17.3(a) apply and therefore Ausgrid is required to apply the RIT-D to this project. Accordingly, Ausgrid has initiated this RIT-D to replace the 33kV switchgear at Sydney Airport ZS in order to identify a preferred option that would ensure Ausgrid is able to satisfy its reliability and performance standards in supplying the airport.

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. It sets out the reasons for Ausgrid's determination, including the methodologies and assumptions used. A full discussion of asset conditions and the identified need can be found in the Final Project Assessment Report (FPAR) for Ensuring reliability requirements in the Sydney Airport area.

[1] https://www.pc.gov.au/__data/assets/pdf_file/0003/231438/sub053-airports.pdf

2 Electricity demand

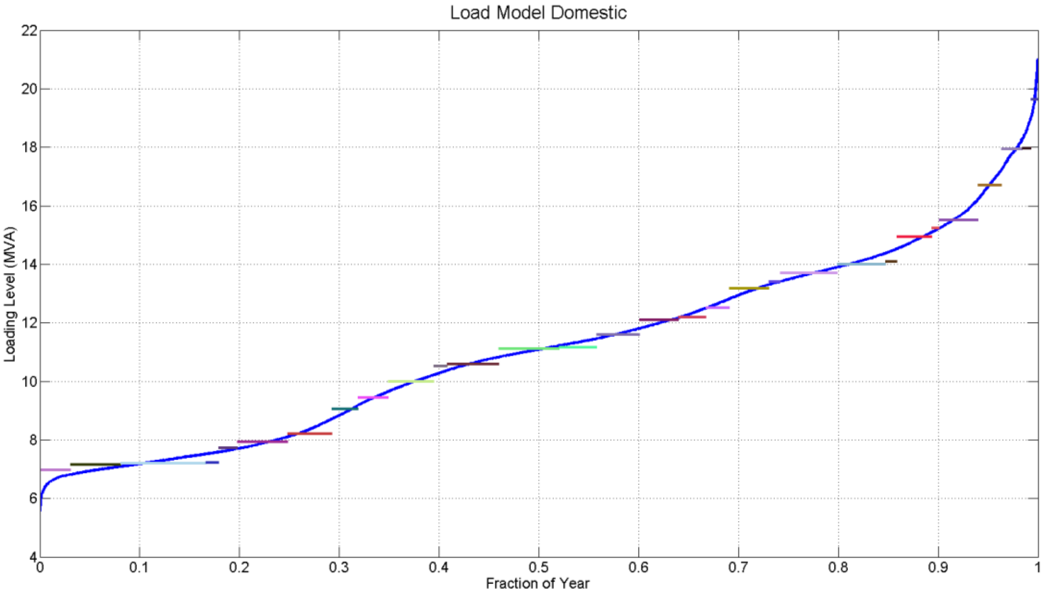
2.1 Load duration curve

Maximum demand at the Sydney Airport zone substation occurs in summer and was 24.8MVA in 2017/18, net of on-site generation. Over the next 10 years, the load at Sydney Airport ZS is forecast to increase to 32MVA as airport developments are realised.

The load duration curve for Sydney Airport zone substation is presented in **Error! Reference source not found.**1 below.

As Sydney Airport zone substation supplies a single customer, it is assumed that the load types supplied by this substation will not change substantially into the future and therefore the load duration curve will maintain its characteristic shape. The load duration curve is used to determine the energy at risk and/or the amount of load curtailment required at certain load levels and is a direct input into the modelling of the Expected Unserved Energy (EUE), which is the probability weighted amount of load that would be unmet due to network capacity limitations. Ausgrid has forecast load over the assessment period and has quantified the EUE by comparing forecast load to network capabilities, which include load transfer capabilities and downstream generation (refer to Section 3), under system normal and network outage conditions.

Figure 1: Load duration curve for Sydney Airport



Note that the identified need at Sydney Airport ZS is not directly related to the level of electricity demand; rather, it is driven by aged asset issues. Further discussion about aged asset issues is provided in section 3 below.

3 Aged asset issues

Although Sydney Airport ZS was commissioned in 1969, the 33kV switchgear is dated back to 1955 having been re-used from elsewhere on Ausgrid’s network. The 33kV oil circuit breakers are some of the oldest still in use on the Ausgrid network and are of a unique type with very limited spare parts availability.

The switchgear installed in Sydney Airport ZS is compound insulated and has bituminous compound insulation busbars (switchboard) and oil-filled circuit breakers which can act as a fuel source and may result in significant consequential damage in the event of failure. The switchgear itself is considered to be beyond its design life.

In the past oil-filled switchgear failures have resulted in a range of adverse consequences ranging from single equipment failures to multiple equipment failures impacting the operation of the entire substation. Consequently, Ausgrid has assumed that the ageing assets (i.e. compound insulated 33kV switchgear) at Sydney Airport ZS have an unacceptable risk of failure resulting in a corresponding risk of involuntary load shedding and risk to the safety of operational staff.

In the event of failure of the 33kV switchgear and subsequent loss of supply to Sydney Airport ZS, the recovery strategy would include supply from on-site generation and load transfers from Sydney Airport ZS to International Terminal ZS. There is an estimated 5MVA load transfer capability (LTC) between Sydney Airport ZS and International Terminal ZS. Supply to the balance of the load at Sydney Airport ZS would be subject to completion of repair/replacement of damaged 33kV switchgear and associated equipment for restoration of supply.

4 Proposed preferred network option

This section provides details of the options that Ausgrid identified in the network planning process and identification of the proposed preferred option. Several options were considered and assessed in consultation with the customer. A number of options were considered non-credible as they do not meet the customer's reliability needs and/or imposed operational constraints for the customer. Some options could technically address the identified need but are likely to cost significantly more than the proposed preferred option without any significant increase in benefits.

On this basis, Ausgrid has therefore identified one credible option which is technically and economically feasible. More details of the other options are set out in Table 1.

The credible option identified by Ausgrid is:

Option 1: Replacement of the 33kV switchgear in a new switchroom, which will improve reliability, reduce unserved energy levels and reduce operating expenditure over time. Additionally, this option will also avoid construction and network risks and will provide the opportunity to incorporate greater fire segregation between 33kV busbar sections. Therefore, replacing the 33kV switchgear in a new switchroom is the only credible option. As agreed between Ausgrid and SACL, SACL will construct and provide a new 33kV switchroom building to house Ausgrid's new 33kV switchgear.

Ausgrid also considered several other options that have not been progressed. In general, these options have not progressed because they were found to be economically infeasible or technically infeasible.

The table below summarises Ausgrid's consideration and position on each of these potential options.

Table 1 – Summary of the options considered but not progressed

Option not progressed	Description	Reason why option was not progressed
Brownfield development: replace the switchgear in-situ	Replacing the Sydney Airport ZS 33kV switchgear with new equipment in the existing switchroom building.	Sydney Airport has identified condition issues with the existing switchroom building and is proposing to demolish the existing building and remediate the site. In situ redevelopment would also pose significant operational and schedule risks to the airport during construction.
Retirement of Sydney Airport ZS via 11kV load transfer	Retiring the Sydney Airport ZS and transfer of load to surrounding zones via 11kV load transfer. Both 11kV and 33kV network would need to be rearranged significantly. This option is expected to cost significantly more than the preferred option.	This option is deemed as not feasible as it costs significantly more and will impose construction issues and capacity constraints to the remaining network. The surrounding zones do not have spare capacity to absorb the current and future airport load. The option is not feasible from both Ausgrid's perspective and the customer's point of view.
Establish a new 132/11kV zone substation	This option involves retirement of the 33/11kV Sydney airport ZS and replace it with a new 132kV ZS. Both 33kV and 132kV network would need to be rearranged significantly. This option is expected to cost significantly more than the preferred option.	This option is considered as not economically feasible as it would cost several times more than the combined replacement of both 33kV and 11kV switchgear, without providing a commensurate increase in benefits and bringing forward replacement investments in subtransmission feeders by at least 7 years.
Rearrange 33kV supply	Rearranging supply and retiring the 33kV	This option was rejected by the customer,

by connecting the 33kV cables directly to the 33/11kV transformers	busbar and the 33kV switchgear. Under this option, the 33kV cables would be directly connected to the 33/11kV transformers.	claiming that it would reduce reliability of supply and operational flexibility, as well as limiting future growth. In addition, this option has significant construction risks.

Ausgrid has elected to assess the network option against three alternative future scenarios – namely:

- Low benefit scenario – Ausgrid has adopted a number of 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 the key variables in each scenario is provided in the Table 2 following.

Table 2 – Summary of the three scenarios investigated

Variable	Baseline scenario	Low benefits scenario	High benefits scenario
Capital cost	100 per cent of capital cost estimate	125 per cent of capital cost estimate	75 per cent of capital cost estimate
Unplanned corrective maintenance cost	100 per cent of baseline corrective maintenance cost estimates	70 per cent of baseline corrective maintenance cost estimates	130 per cent of baseline corrective maintenance cost estimates
Demand	Current Peak Load and combined 10MVA LTC and additional Embedded Generation allowance	Current Peak Load and combined 15MVA LTC and additional Embedded Generation allowance	Current Peak Load and combined 5MVA LTC and additional Embedded Generation allowance
VCR	$41/kWh	$29/kWh	$53/kWh
Discount rate	3.22 per cent	3.22 per cent	3.22 per cent

Note that the known existing load transfer capacity with the International Terminal zone substation through the customer's 11kV network is 5MVA. The scenarios shown above have made a conservative assumption of 10MVA in load transfer capacity for the baseline scenario; though there are no committed investments or confirmed plans to increase 11kV interconnections between Sydney Airport ZS and International Terminal ZS and/or increase embedded generation capacity.

Refer to the Final Project Assessment Report for this project for further details about the options assessment methodology and scenario analysis.

Preferred option at this draft stage

Ausgrid proposes Option 1 to be the preferred option, as the proposed preferred option satisfies the RIT-D. Ausgrid is the proponent for Option 1 and has presented this project to SACL. The estimated cost of this option is approximately $6.6 million in FY2019/20 dollars.

Ausgrid anticipates works would commence in 2020/21 with the commissioning of the new 33kV switchgear and transfer of 33kV load expected to be completed in 2021/22 and subsequent decommissioning of the aged network assets in

2022/23. Once the replacement is complete, operating costs are assumed to be approximately 0.5% of capital expenditure, equivalent to $33,000 per annum.

Sydney Airport will fund the construction of the new 33kV switchroom, control room and associated civil works to Ausgrid specifications. Ausgrid will fund the procurement and installation of the new 33kV switchgear equipment, the transfer of the existing 33kV feeders to the new switchgear and the decommissioning of the existing 33kV switchgear equipment. Specific tariff arrangements have been established to recover the cost of the assets required to supply Sydney Airport over a long-term period.

5 Assessment of non-network solutions

5.1 Required demand management characteristics

As noted in Section 3, an outage originating from a fire involving the 33kV switchgear may result in a supply shortfall of the entire load supplied to Sydney Airport ZS. In 2021/22 this is a minimum of about 20 MVA after realising 5MVA of load transfer capability to International Airport ZS. To be considered a feasible option, any demand management solution must be technically feasible, commercially feasible; and able to be implemented in sufficient time by 2021/22 for deferral of the network investment.

5.2 Available demand management funds

To identify the available funds for a possible demand management solution, the net NPV benefit for the network option is compared with the net NPV benefit of a deferral of the preferred network option.

Table 3 below shows the available funds for a deferral of the network investment for 1, 2 and 3 years.

Table 3 – Required demand reductions at Sydney Airport ZS

Required peak demand reduction	Available funds		
	1 Yr deferral	2 Yr deferral	3 Yr deferral
20 MVA	$0.46m	$0.89m	$1.29m

The required demand reduction assumes the 5MVA load transfer capability to the International Terminal zone substation can be fully realised and that for the purpose of determining the feasibility of demand management solutions as outlined in section 5.3 below, there is zero additional embedded generation (AEG) which is referred to in section 4.3 of the FPAR. The required demand reduction also assumes that the current pattern of use from the airport's existing on-site generation (operating at full capacity at times of peak demand) is maintained.

5.3 Demand management options considered

Ausgrid has considered a number of demand management solutions to determine their commercial and technical feasibility to assist with the identified need at the Sydney Airport ZS. Each of the demand management solutions considered is summarised below.

5.3.1 Customer power factor correction

As a mature and proven demand management solution, customer power factor correction is both technically feasible and offers reliable permanent reductions sufficient at a low cost. Analysis of customer interval data indicates the existing power factor is already quite high, above 0.90, with a technical potential of about 2300 kVA during times of high demand. Corresponding commercial potential is likely to be about 1900 kVA. At a projected demand management cost of about $25-50 per kVA, the estimated cost to achieve commercial potential is about $50-100,000.

This solution might be cost effective but would contribute about 10% of the 20 MW demand reduction required.

5.3.2 Customer solar power systems

Customer solar power systems as a demand management solution provides a financial incentive to customers to invest in new solar power systems such that an accelerated take-up of solar reduces the forecast demand and energy overload conditions. Analysis of interval data for Sydney Airport ZS shows that while solar generation is partially coincident with the energy shortfall, it offers no reduction in load during non-solar hours. As the shortfall is across all hours in the year (base load of 5MVA), a non-dispatchable solar power system would offer no support outside of daylight hours.

Assuming that customer power factor correction measures (commercial potential) of around 1.9MVA can be achieved, this results in about 18MVA of further demand reductions required net of downstream generation.

To assess the viability of this solution, we estimated the potential cost and impact from a hypothetical incentive program to encourage customer investment in solar power. If we assumed that incentives of about 25% of customer investment might encourage additional customer take-up of solar that would otherwise not occur, an incentive of about $250 per kVA for a 5MW solar power system would require a customer incentive payment of about $1.25 million, or about 100% of the available funds for a 3-year deferral. As solar power system generation is subject to hourly, seasonal and cloud cover variation, we estimate that a 5MW solar array would generate up to 7GWh annually, equivalent to less than 10% of the customer's present annual net energy consumption.

This indicates that utilising 100% of the available funds to incentivise a 5MW customer solar power system would address only a small component of the energy shortfall. Consequently, we consider there is insufficient funds available for this solution to be considered part of a cost-effective alternative.

Note that no detailed assessment of the viability of this scale of solar power has been made. The estimate has been derived to test whether the option offers material energy and demand reductions at a cost that indicates it may form part of an economic alternative to the network option.

5.3.3 Customer energy efficiency

Customer energy efficiency improvements as a demand management solution provides a financial incentive to customers to accelerate take-up of energy efficiency improvements with the aim of reducing their forecast energy consumption and the impact of overload conditions. Sydney Airport is already proactive in terms of their energy management. In 2018 their energy efficiency initiatives included upgrades to their lighting and baggage handling systems.[2]

Assuming that customer power factor correction measures (commercial potential) of around 1.9MVA can be achieved, this results in about 18MVA of further demand reductions required net of downstream generation.

To assess the viability of this solution, we estimated the potential cost and impact from a hypothetical incentive program to encourage customer investment in energy efficiency improvements. If we assumed that incentives of about 20-40% of customer investment might encourage additional customer take-up of energy efficiency improvements than would otherwise not occur, an incentive of about $500-1000 per kVA incentive might achieve up to 1.3-2.6MVA and 4-8GWh in annual energy efficiency savings using 100% of the available funds for a 3-year deferral. Similar to the solar power system option, this would address only a small component of the energy shortfall. Consequently, we consider there is insufficient funds available for this solution to be considered part of a cost-effective alternative.

Note that no detailed assessment of existing customer load or potential energy efficiency opportunities has been made. The estimate has been derived to test whether the option offers material energy and demand reductions at a cost that indicates it may form part of an economic alternative to the network option.

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2 https://assets.ctfassets.net/v228i5y5k0x4/4601gBqOhHbkmYhkfleZPL/db41f43b16c6111b17c4c3c6ff4ee00d/Sydney_Airport_Sustainability_Report_2018.pdf

5.3.4 Demand response

Demand response is the most common demand management option and offers a relatively mature solution for standard network overload needs. Demand response can involve either or both a temporary reduction in customer load and the use of embedded generation to either replace grid supplied electricity to the customer or export to the local grid. For the purposes of this option, we have assumed that this solution could address the short duration peak demand at Sydney Airport ZS, or for about 100-200 hours per year across the net load profile which already includes the impact of existing downstream generation plant. In this context, demand response would be restricted to voluntary load shedding or new generators (temporary or permanent).

To assess the viability of this solution, we estimated the potential cost and impact from a hypothetical demand response program that reduced peak demand for the top 100-200 hours, or up to 4MVA. Past practice shows that costs for traditional demand response from commercial and industrial (C&I) customers is in the range of $50-150 per kW for 40-100 hours of dispatch and 3-5 months availability. If it was assumed that demand response could be acquired for an estimated $75-125 per kVA per year for 12 months availability, the cost for 4MVA of demand response for 3 years would be about $0.9-1.5m, or about 80-120% of the available funds for a 3-year deferral. As this solution would only address a very small component of the energy shortfall, we consider there is insufficient funds available for this solution to be considered part of a cost-effective alternative.

Note that no detailed assessment of the demand response availability and customer willingness to contract has been made. The estimate has been derived to test whether the option offers material energy and demand reductions at a cost that indicates it may form part of an economic alternative to the network option.

5.3.5 Large customer energy storage

While this option is technically feasible and offers a viable form of demand response, current and near-term pricing indicates that the solution would not be economic in comparison with demand response. At an estimated cost of over $1m per MWh, a peak lopping storage solution to address the top 100-200 hours would need to leverage significant other market benefits to be viable and yet would only address a very small component of the energy shortfall. We therefore consider there is insufficient funds available for this solution to be considered part of a cost-effective alternative.

6 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