Jemena Electricity Networks (Vic) Ltd

Sunbury - Diggers Rest Electricity Supply

RIT-D Stage 1: Non-Network Options Report

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Sunbury - Diggers Rest Electricity Supply

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GLOSSARY

Amperes (A)	Refers to a unit of measurement for the current flowing through an electrical circuit. Also referred to as Amps.
Constraint	Refers to a constraint on network power transfers that affects customer service.
Continuous rating	The permissible maximum demand to which a conductor or cable may be loaded on a continuous basis.
Jemena Electricity Networks (JEN)	One of five licensed electricity distribution networks in Victoria, the JEN is 100% owned by Jemena and services over 319,000 customers via an 11,000 kilometre distribution system covering north-west greater Melbourne.
Maximum demand (MD)	The highest amount of electrical power delivered (or forecast to be delivered) for a particular season (summer and/or winter) and year.
Megavolt ampere (MVA)	Refers to a unit of measurement for the apparent power in an electrical circuit. Also million volt-amperes.
Network	Refers to the physical assets required to transfer electricity to customers.
Network augmentation	An investment that increases network capacity to prudently and efficiently manage customer service levels and power quality requirements. Augmentation usually results from growing customer demand.
Network capacity	Refers to the network's ability to transfer electricity to customers.
Probability of exceedance (POE)	The likelihood that a given level of maximum demand forecast will be met or exceeded in any given year.
Regulatory Investment Test for Distribution (RIT-D)	A test established and amended by the Australian Energy Regulator (AER) that establishes consistent, clear and efficient planning processes for distribution network investments over a certain limit ($5m), in the National Electricity Market (NEM).
Reliability of supply	The measure of the ability of the distribution system to provide supply to customers.
System normal	The condition where no network assets are under maintenance or forced outage, and the network is operating according to normal daily network operation practices.
10% POE condition (summer)	Refers to an average daily ambient temperature of 32.9ºC derived by NIEIR and adopted by JEN, with a typical maximum ambient temperature of 42ºC and an overnight ambient temperature of 23.8ºC.
50% POE condition (summer)	Refers to an average daily ambient temperature of 29.4ºC derived by NIEIR and adopted by JEN, with a typical maximum ambient temperature of 38.0ºC and an overnight ambient temperature of 20.8ºC.
50% POE and 10% POE condition (winter)	50% POE and 10% POE condition (winter) are treated the same, referring to an average daily ambient temperature of 7ºC, with a typical maximum ambient temperature of 10ºC and an overnight ambient temperature of 4ºC.

ABBREVIATIONS

AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
COO	Coolaroo Zone Substation
JEN	Jemena Electricity Networks
KTS	Keilor Terminal Station
MD	Maximum Demand
NEM	National Electricity Market
POE	Probability of Exceedance
RIT-D	Regulatory Investment Test for Distribution
SA	St. Albans Zone Substation
SBY	Sunbury Zone Substation
SHM	Sydenham Zone Substation
TTS	Thomastown Terminal Station
VCR	Value of Customer Reliability

OVERVIEW

Jemena is the licensed electricity distributor for the northwest of Melbourne's greater metropolitan area. The network service area ranges from Gisborne South, Clarkefield and Mickleham in the north to Williamstown and Footscray in the south and from Hillside, Sydenham and Brooklyn in the west to Yallambie and Heidelberg in the east.

Our customers expect us to deliver a reliable electricity network service at the lowest possible cost. To do this, we must choose the most efficient solution to address emerging network issues. This means choosing the solution that maximises net benefits. In some cases, non-network solutions – such as embedded generation or demand management – may be more efficient than investing in network assets with long asset lives. Effective engagement with non-network proponents is essential in order for us to identify and assess credible non-network options.

The purpose of this non-network options report is to commence this engagement with non-network proponents in relation to the network issues in the Sunbury and Diggers Rest growth corridor, and particularly the emerging constraints and reliability issues at the Sunbury Zone Substation (SBY).

The Sunbury and Diggers Rest area has experienced very significant urban development since the original construction of the SBY in 1964. SBY remains the predominant source of supply to the area, with some support from Sydenham (SHM) Zone Substation and one feeder from Coolaroo (COO) Zone Substation. Sunbury and Sydenham Zone Substations are both supplied from Keilor Terminal Station, and Coolaroo is supplied from Thomastown Terminal Station.

Identified need

The Sunbury and Diggers Rest area is located within the Victorian Government's urban growth boundary, and the Metropolitan Planning Authority is currently preparing five Precinct Structure Plans for development of the areas surrounding the Sunbury CBD. With these developments expected to lead population growth in the area, maximum demand is expected to grow at an average annual rate of 2.8% over the next 10 years.

The capacity of SBY Zone Substation is provided by two 10/16 MVA 66/22 kV transformers and one 10 MVA 66/22 kV transformer. The overall station transformers' normal rating, (i.e. N rating), is effectively 32 MVA (instead of 42 MVA), due to the 10 MVA transformer reaching its limit first before the other two transformers are fully utilised.

Since the 2012/13 summer, load transfers to nearby Sydenham (SHM) Zone Substation and Coolaroo (COO) Zone Substation have taken place to manage the imminent overload of SBY under system normal condition. Contingency transfer under system normal condition is used only as temporary relief rather than a permanent solution, as this places additional risks on the adjacent SHM Zone Substation, and the feeder where the transfer was made. From 2018 onwards, for system normal condition there will be insufficient capacity at SBY Zone Substation over the summer peak load period (including contingent load transfer to SHM and COO) to supply the forecast maximum load demands. Accordingly, the risk of supply interruption at SBY has been assessed as being very high for summer 2017/18.

Current estimates indicate that the base case (or 'do nothing' option) would lead to unserved energy with a present value cost to customers of approximately $125 million over the period to 2024 and $378 million until 2032 (when the current lease over the SBY site expires). An exposure of this magnitude would justify significant expenditure to address the network need. As already noted, however, Jemena's approach is to address this issue in a manner that maximises the net benefit for our customers.

In addition to the forecast overload of transformers, some station assets are unreliable, aged, and in a condition requiring replacement in the near future. The 10 MVA transformer is already sixty-four years old, which is beyond its nominal life of 50 years. When the station was originally developed, in 1964, it was built with a basic and cost effective switching arrangement that was appropriate for the small and remotely located load that it originally supplied. The site was designed using outdoor switchgear with transformers in a single switching zone, which is prone to faults caused by wildlife contact. Most faults within the station will result in a supply interruption to all customers supplied from SBY.

Options analysis results and preferred network option

Options to alleviate emerging constraints in the SBY Zone Substation are considered in the light of the long term development plans for the area. Jemena has identified the following credible network options to address the investment need:

- Option 1 – Augment and redevelop the SBY Zone Substation to current standards by the end of 2018;
- Option 2 – Augment and redevelop the SBY Zone Substation to current standards by the end of 2018. Develop a new zone substation with two transformers over the period from 2021 to 2025. Demolish and handover the existing SBY site in 2032; and
- Option 3 – Establish a new zone substation by the end of 2018 with the intent of vacating the existing SBY site by 2032.

Jemena has also assessed embedded generation and demand side management as potential credible non-network options.

Based on our provisional analysis it appears that Option 1, which is to redevelop and augment Sunbury zone substation by November 2018, is the preferred network option. Our initial indicative estimate suggests that the network augmentation charge would be approximately $1 million per annum, and would deliver a total net benefit of approximately $364 million in present value terms. These estimates are indicative only, and a full analysis including sensitivity testing, will be provided in the Draft Project Assessment Report (RIT-D Stage 2).

As already explained, the purpose of this report is to identify credible non-network options that may provide a more cost effective solution than Option 1. To assist non-network proponents, we describe the technical characteristics of our network needs at SBY. Importantly, however, this information is only intended to guide non-network proponents in developing credible non-network options. Jemena welcomes an open dialogue with non-network proponents to identify potential alternatives to the network options identified in this paper.

After we consider submissions on this non-network options report, we will proceed to prepare a more detailed Draft Project Assessment Report. That report will apply the latest available information on demand forecasts, VCR estimates and project cost estimates to assess the network and non-network solutions to the identified need. Information on the next steps in the assessment process and contact details are provided in Section 7 of this report.

1. INTRODUCTION

1.1 PURPOSE

Distribution businesses are required to go through a process (the Regulatory Investment Test for Distribution, or "RIT-D") to identify investment options which best address an identified need on the network. The RIT-D applies in circumstances where a network problem (an "identified need") exists and the estimated augmentation component capital cost of the most expensive potential credible option to address the identified need is more than $5 million. As part of the RIT-D process, distribution businesses must also consider non-network options when assessing credible options to address the identified need.

Under the RIT-D consultation procedures, distribution businesses are required to prepare and publish a non-network options report. This report helps distribution businesses to identify potential non-network options and be better informed on the costs and market benefits associated with a potential option. These arrangements provide an opportunity for third parties to consider how they could address the distributor's identified need on the network.

This document is Jemena's non-network options report for the Sunbury and Diggers Rest area. In accordance with the requirements of the National Electricity Rules this report describes:

- the identified need in relation to the Sunbury and Diggers Rest network;
- the potential credible network options that may address this need; and
- the technical characteristics of a credible non-network option.

1.2 OBJECTIVE

Jemena's objective is to ensure that reliable distribution services are delivered to its customers at the lowest sustainable cost. Non-network solutions have an important role to play in meeting this objective.

This report is an initial step in our engagement with non-network proponents in relation to addressing the identified need in the Sunbury and Diggers Rest network. Jemena welcomes an open dialogue with non-network proponents to ensure that the best solution is adopted, whether that solution is a network, non-network or combined project.

1.3 STRUCTURE OF THIS REPORT

The remainder of this report is structured as follows:

- Section 2 provides background information on the network location and assets;
- Section 3 describes the identified need that is to be addressed;
- Section 4 summarises the methodology and assumptions employed in assessing the credible options;
- Section 5 sets out the credible network options and provides an indicative assessment of their respective augmentation costs;
- Section 6 presents the technical characteristics of the identified need, which should guide non-network proponents in developing credible options; and

- Section 7 sets out our contact details, and provides a guide as to the information that non-network proponents should submit in response to this report. The section also outlines the next steps in the assessment process.

2. BACKGROUND

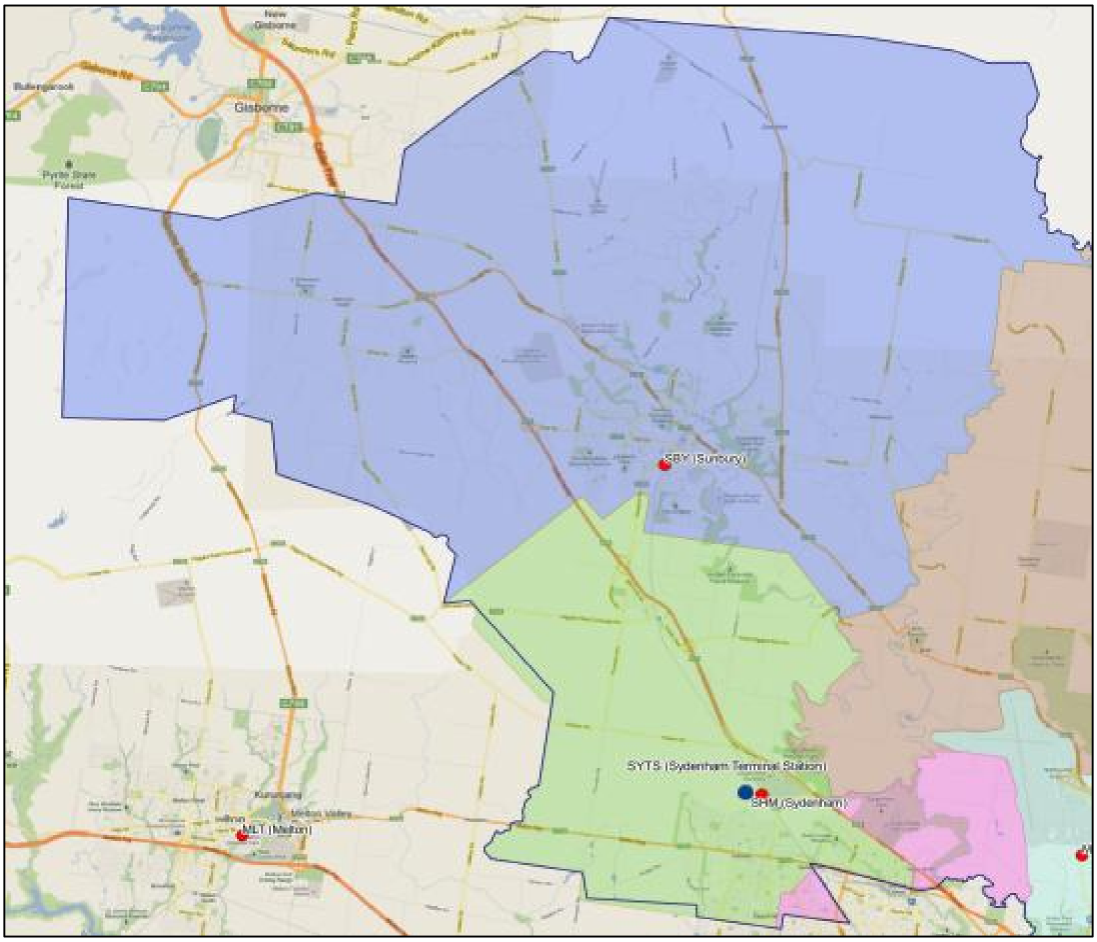
This section provides an overview of the Sunbury area and presents key information about the lines and zone substations that supply the Sunbury and surrounding areas.

2.1 SUNBURY NETWORK AND DRIVERS OF GROWTH

The Sunbury and Diggers Rest area is supplied predominantly by Sunbury (SBY) Zone Substation, with some support from Sydenham (SHM) Zone Substation and one feeder from Coolaroo (COO) Zone Substation. Both SBY and SHM Zone Substations are supplied from Keilor Terminal Station (KTS), and COO Zone Substation is supplied from Thomastown Terminal Station (TTS).

Figure 2–1 below, shows the SBY supply area in blue, and the SHM supply area, to the south of Sunbury, in green. The COO supply area to the east of Sunbury is shown in light brown.

Figure 2–1: SBY and SHM Zone Substation supply areas



The Sunbury area includes a mixture of residential, industrial and commercial load. SBY Zone Substation currently supplies over 15,100 customers and SHM Zone Substation supplies approximately 14,800 customers, including one major HV customer substation. Stand-by supply to the HV customer substation is provided from SBY Zone Substation.

The supply area also includes one rural feeder from COO Zone Substation, COO-11, which currently supplies the area to the eastern boundary of the Sunbury and Diggers Rest supply area.

The Sunbury and Diggers Rest area is located within the Victorian Government's urban growth boundary, and the Metropolitan Planning Authority is currently preparing five Precinct Structure Plans for development of the areas surrounding the Sunbury CBD. With these developments expected to lead population growth in the area, maximum demand is expected to grow at an average annual rate of 2.8% over the next 10 years.

JEN has already experienced rapid load growth in the areas around Sunbury, Sydenham and Diggers Rest, which has led to a need to invest in the area to reliably meet the growing demand in this developing area. In addition, JEN has received many applications for new connections of residential, commercial and industrial customers, which are forecast to further drive load growth and network development requirements over the next five years.

Strong load growth is expected to continue to be driven by the development of residential housing estates and commercial activities associated with the projected increases in population. Plans are well advanced to develop transport infrastructure in the area, such as electrification of the rail line and construction of the outer ring road. Such developments will increase both the residential and commercial attractiveness of the area, and encourage further growth.

2.2 CONNECTIVITY AND ASSET INFORMATION SUMMARY

2.2.1 ZONE SUBSTATIONS

Sunbury Zone Substation (SBY)

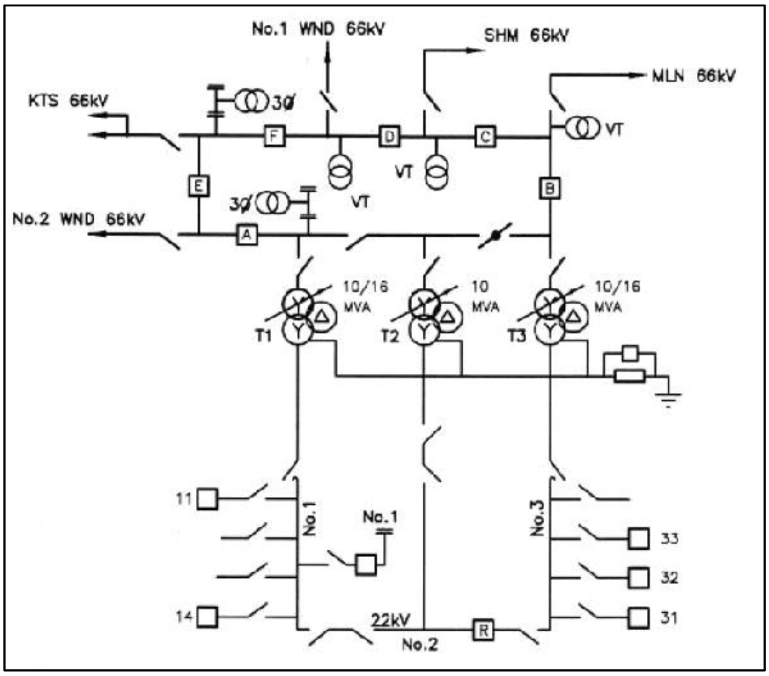
Sunbury (SBY) Zone Substation was originally developed as a country, or regional type zone substation. It was designed to provide both a 66 kV switching station for the sub-transmission network supplying the wider area to the north and west of Melbourne, and to provide distribution supply to the township of Sunbury and its surrounds.

SBY Zone Substation originally featured three 5 MVA transformers, outdoor switchgear and limited station switching, resulting in a single switching zone for all transformers. As loading on the substation increased over time, the three 5 MVA transformers were replaced with larger units, and the station now consists of one transformer rated at 10 MVA and two transformers rated at 10/16 MVA. Although the sum of nameplate ratings of the transformers is 42 MVA, the effective normal summer rating of the substation is limited by the amount of power that can be supplied through the smallest transformer. Due to the transformer impedance differences, and the resultant load sharing across the three transformers, the load through the 10 MVA transformer reaches its rated value at a station load of 32 MVA. This 32 MVA capacity has therefore been assigned as the effective normal summer rating of SBY Zone Substation.

The 66 kV switching is supplied in a ring bus arrangement and the local distribution is via transformers in a single switching zone. The current substation layout largely reflects its initial design with outdoor 66 kV and 22 kV switch gear and a strung bus arrangement for both 66 kV and 22 kV buses. The strung bus arrangement is less reliable than a rigid bus configuration as the probability of conductor clashing during faults, wild life contact and extreme weather conditions is higher due to conductor flexibility.

Figure 2–2 shows that SBY Zone Substation's existing switching arrangement provides no individual switching of the transformers or 22 kV buses. Because of this arrangement, the substation is inherently less reliable than typical zone substations that have fully switched transformers and 22 kV buses.

Figure 2–2: SBY Zone Substation single line diagram



Sydenham (SHM) Zone Substation

Sydenham (SHM) Zone Substation is a summer critical station consisting of two 20/33 MVA transformers, providing a total nameplate rating of 66 MVA. SHM Zone Substation has a summer N-1 cyclic rating of 38 MVA and a winter N-1 cyclic rating of 39.6 MVA.

2.2.2 DISTRIBUTION NETWORK

SBY 22 kV feeders

The area under consideration is supplied from SBY Zone Substation by five feeders. Feeder SBY-14 supplies the Sunbury CBD and the eastern side of Sunbury, whereas SBY-31 supplies the central part of Sunbury. Similarly, SBY-11, SBY-32 and SBY-33 spread out west, northwest and south, respectively, from SBY Zone Substation. SBY-13 provides a dedicated standby supply to a HV customer substation.

The summer ratings and number of customers connected to each feeder are provided in Table 2-1.

Table 2-1: SBY 22 kV feeder capacity and customer numbers

Feeder	Rating (A)	Customer numbers
SBY-11	330	2,970
SBY-13	630	1
SBY-14	375	4,095
SBY-31	375	2,102
SBY-32	230	2,912
SBY-33	375	2,986

SHM 22 kV feeders

There are five 22 kV feeders originating from SHM Zone Substation. Feeder SHM-24, which was commissioned in 2012, provides a dedicated supply to a HV customer, and is supported by feeder SBY-13. The area under consideration is only supported by feeder SHM-11. The summer rating and number of customers on this feeder is provided in Table 2-2.

Table 2-2: SHM-11 22 kV feeder capacity and customer numbers

Feeder	Rating (A)	Customer numbers
SHM-11	375	1,040

COO 22 kV feeders

There are six feeders originating from COO Zone Substation. Only one of them, COO-11, supports feeder SBY-14 in the eastern side of the Sunbury area. The summer rating and number of customers connected to this feeder is presented in Table 2-3.

Table 2-3: COO-11 22 kV feeder capacity and customer numbers

Feeder	Rating (A)	Customer numbers
COO-11	375	1,663

2.2.3 EMBEDDED GENERATION

Other than small scale residential solar PV, there is no embedded generation connected to offset the sub-transmission loop and zone substation loading issues for network support in the supply area under consideration.

2.2.4 DEMAND SIDE MANAGEMENT

There are no known customers with the potential of reducing the demand for network services in the supply area under consideration.

3. DESCRIPTION OF IDENTIFIED NEED

This section describes the investment need in relation to Sunbury (SBY) Zone Substation.

3.1 LOAD FORECASTS AND EMERGING CONSTRAINTS AT SBY ZONE SUBSTATION

SBY Zone Substation is a summer critical station. As noted in Section 2.2.1, SBY's capacity is provided by two 10/16 MVA transformers and one 10 MVA transformer, providing a total nameplate rating of 42 MVA. Due to the lower capacity transformer, 32 MVA is the effective summer rating applied to SBY.

SBY has a summer N-1 cyclic rating of 26.4 MVA, based on the critical outage being loss of either of the two 16 MVA transformers.

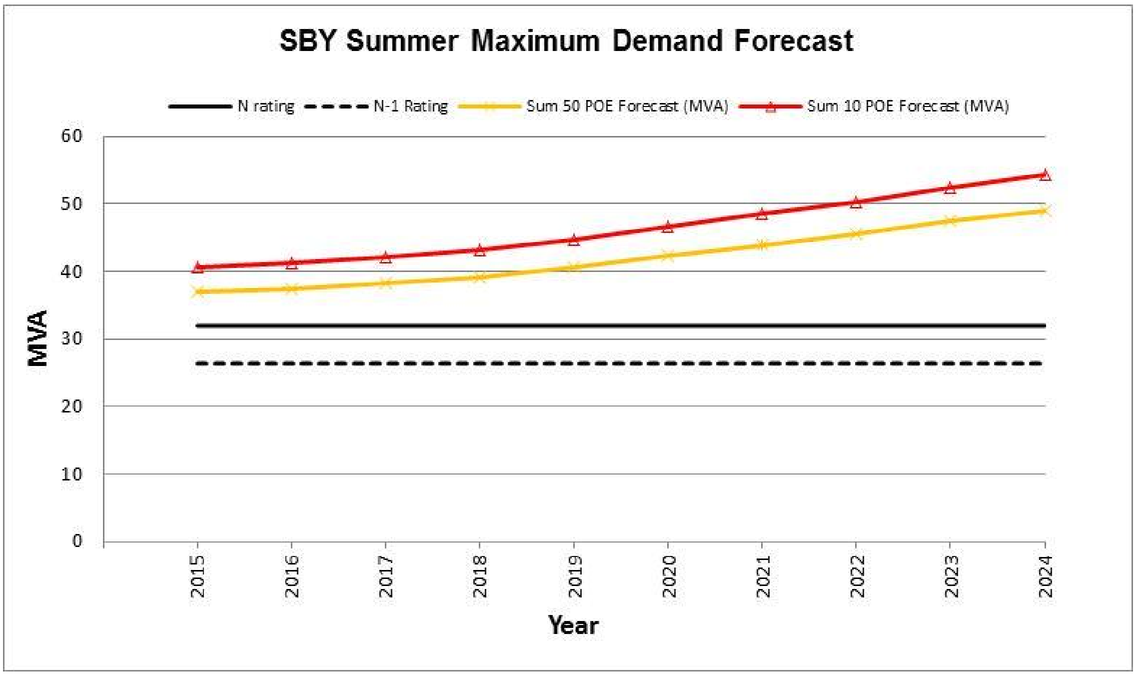
Table 3-1 presents SBY Zone Substation's actual maximum demand for summer 2014, and the summer and winter 50% Probability of Exceedance (POE) and 10% POE maximum demand forecasts from winter 2014 through to 2024 based on 2014 forecasts.

Table 3-1: SBY Zone Substation load demand forecast

Name	S/W	Actual (Summer 2014) & Forecast (from Winter 2014) Maximum Demand (MVA)										
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
SBY	Summer (50% POE)	36.7	37.0	37.4	38.3	39.2	40.6	42.3	43.9	45.7	47.5	49.1
	Winter (50%POE)	29.0	29.5	30.0	30.8	31.7	33.0	34.4	35.8	37.3	39.0	40.8
	Summer (10% POE)	36.7	40.6	41.2	42.1	43.2	44.7	46.6	48.5	50.2	52.4	54.4
	Winter (10%POE)	29.7	30.2	30.7	31.5	32.4	33.7	35.2	36.6	38.2	39.9	41.7

Figure 3–1 presents the SBY Zone Substation summer demand forecasts compared to the station's capacity. It shows that, under 50% POE and 10% POE summer maximum demand conditions, the substation loading already exceeds its system normal rating, and its N-1 cyclic rating with either one of the 16 MVA transformers out of service.

Figure 3–1: SBY Zone Substation summer load demand forecast



The summer peak load (MVA) at risk under 10% POE and 50% POE, allowing for load transfer capability, is summarised in Table 3-2. It shows that, from 2015 onwards, there is significant load at risk under 10% POE system normal condition and at N-1 condition under 50% POE conditions. From 2017 onwards, load at risk will arise under system normal conditions at 50%POE.

Table 3-2: Load at risk at SBY Zone Substation

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
50% POE MD (MVA)	37.0	37.4	38.3	39.2	40.6	42.3	43.9	45.7	47.5	49.1
10% POE MD (MVA)	40.6	41.2	42.1	43.2	44.7	46.6	48.5	50.2	52.4	54.4
50% POE Transfer capacity (MVA)	7.0	5.6	3.7	2.0	0.4	-	-	-	-	-
10% POE Transfer capacity (MVA)	6.5	5.2	3.2	1.2	-	-	-	-	-	-
Zone Substation N Rating (MVA)	32	32	32	32	32	32	32	32	32	32
Zone Substation N-1 Cyclic Rating (MVA)	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
N Load at risk under 50% POE (MVA)	-	-	2.6	5.2	8.2	10.3	11.9	13.7	15.5	17.1
N-1 Load at risk under 50% POE (MVA)	3.6	5.4	8.2	10.8	13.8	15.9	17.5	19.3	21.1	22.7
N Load at risk under 10% POE (MVA)	2.1	4.0	6.9	10.0	12.7	14.6	16.5	18.2	20.4	22.4
N-1 Load at risk under 10% POE (MVA)	7.7	9.6	12.5	15.6	18.3	20.2	22.1	23.8	26.0	28.0

In addition to the load at risk in Table 3-2, Jemena is contracted to provide stand-by supply of 3 MVA to a HV customer. This capacity must be available in the event that the normal SHM supply feeder is out of service.

Using the VCR described in Section 4.3, Jemena estimates the value of expected unserved energy over the period to 2024 to be approximately $125 million and approximately $387 million to 2032 (the end of current SBY lease term) in present value terms. It should be noted that this calculation is based on a number of assumptions and inputs that may be refined in our subsequent analysis in the Draft Project Assessment Report. At this stage, however, the expected unserved energy is sufficiently high to warrant a network augmentation.

Contingency load transfers to nearby Sydenham (SHM) and Coolaroo (COO) Zone Substations have been utilised since summer 2012/13 to maintain loading at SBY to within the station’s rating during times of summer maximum demand under system normal condition. The load transfer is a temporary measure rather than a permanent solution, as it places additional risks on SHM and COO.

As noted in Section 2.2.1, SBY Zone Substation is supplied in a ring bus arrangement and the local distribution is via transformers in a single switching zone, meaning that there is no individual switching of transformers or 22 kV buses. The substation consists of outdoor 22 kV switchgear, a strung 66 kV bus and a mixture of strung and solid 22 kV buses. Because of this arrangement, the substation is inherently less reliable than other zone substations which typically have fully switched transformers and 22 kV buses, and indoor 22 kV switchgear. Any event that causes tripping of a 22 kV bus or a 66/22 kV transformer will result in the loss of the whole SBY Zone Substation. Addressing the emerging constraints at SBY Zone Substation provides a potential opportunity to address these reliability issues, subject to the overarching objective of maximising net benefits.

4. ASSESSMENT METHODOLOGY AND ASSUMPTIONS

This section provides a summary of the planning methodology applied in assessing the impact of network limitations, and in identifying and assessing the market benefits of credible options. It also outlines the assumptions, including sensitivities, applied in the economic analysis of credible options.

4.1 PROBABILISTIC PLANNING APPROACH

In accordance with clause 5.17.1(b) of the National Electricity Rules, Jemena's augmentation investment decisions aim to maximise the present value of the net economic benefit to all those who produce, consume and transport electricity in the National Electricity Market.

To achieve this objective, Jemena applies a probabilistic planning methodology that considers the likelihood and severity of critical network outages. The methodology combines the expected impact of network outages on supply delivery with the value that customers place on their supply reliability, and compares this with the augmentation costs required to reduce the likelihood and/or impact of these supply outages.

To ensure the maximisation of net economic benefit, an augmentation will only be undertaken if the benefits, which are typically driven by a reduction in the cost of expected unserved energy, outweigh the cost of the proposed augmentation resulting in that reduction in unserved energy. Since an augmentation will not always be economically feasible, this planning methodology involves an inherent risk that under some possible but rare events - such as the occurrence of a network outage coincident with peak demand periods - there may be insufficient network capacity to meet all demand.

4.2 DEMAND FORECASTS

The demand forecasts used in the preparation of this report are those contained in Jemena's 2014 Distribution Annual Planning Report (DAPR). Updated demand forecasts will be published in Jemena's 2015 DAPR at the end of the year, and those forecasts will be used in the preparation of the Draft Project Assessment Report.

Despite a general slowing in electricity consumption, maximum demand in the Sunbury and Diggers Rest area is forecast to grow at an average annual rate of 2.8% over of the next 10 years. This increasing demand reflects a forecast growth in population, largely driven by the Metropolitan Planning Authority's development of five Precinct Structure Plans for the area surrounding Sunbury. The emerging constraint at SBY Zone Substation reflects this demand forecast.

In conducting this RIT-D, Jemena will undertake sensitivity analysis to examine the effects of different load growth forecasts. Jemena will provide details of the sensitivity analysis in the Draft Project Assessment Report, which will be published after we have considered submissions on this non-network options report[1].

[1] Under clause 5.17.4(h) of the National Electricity Rules, we must provide at least 3 months for interested parties to lodge submissions on the non-network options report. Clause 5.17.4(i) requires us to publish a Draft Project Assessment Report within 12 months of the end of the consultation period on the non-network options report.

4.3 VALUE OF CUSTOMER RELIABILITY

In assessing the credible options to alleviate the impact of constraints on its network, Jemena has applied VCR values based on the Australian Energy Market Operator's (AEMO) 2014 Value of Customer Reliability Review[2]. Applying the sector values developed by AEMO to our load composition split of approximately 46% commercial, 31% residential and 23% industrial customers, a VCR of $38,400/MWh has been used in preparing this non-network options report. This 2014 VCR estimate will be updated to a 2015 value[3] for the purpose of preparing the Draft Project Assessment Report. VCR sensitivity analysis will also be applied when Jemena conducts its more detailed analysis of the credible options in its Draft Project Assessment Report.

4.4 DISCOUNT RATE

A discount rate of 6.5% real has been applied in undertaking the initial assessment of the network options presented in this report. However, further consideration of the discount rate and sensitivity analysis will be provided in the Draft Project Assessment Report.

4.5 COST ESTIMATES

The capital cost estimates for all network options are indicative costs only. They have been provided by Jemena's Works Delivery team, with consideration given to recent similar augmentation projects and typical unit costs based on industry experience. The capital cost estimates used for the purpose of this non-network options report are expressed in real 2014 dollars.

At this stage, operating costs, the lease cost of the existing SBY site, land acquisition costs and existing feeder augmentation works have not been included in the analysis. However, an indicative total annualised cost estimate for the preferred network option is provided.

Cost estimates will be further refined in the course of Jemena preparing the Draft Project Assessment Report.

[2] AEMO's report is available from http://www.aemo.com.au/Electricity/Planning/Value-of-Customer-Reliability-review

[3] The 2015 VCR estimate will be obtained by applying the escalation methodology set out in section 5 of AEMO's VCR Application Guide. The Application Guide is available from http://www.aemo.com.au/Electricity/Planning/Value-of-Customer-Reliability-review

5. SUMMARY OF POTENTIAL CREDIBLE OPTIONS

This section provides a summary of potential credible options, including network and non-network options that would address the identified need described in section 3. It also identifies the preferred network option.

The analysis of options presented in this report is indicative only, and is subject to change when further detailed information is considered in the preparation of the Draft Project Assessment Report.

5.1 BASE CASE

The Base Case presents the forecast energy at risk assuming none of the potential credible options are implemented. It is used primarily as a comparison case, against which all of the credible options are compared to determine the option that maximises net benefits.

Although the Base Case option is essentially considered to be the ‘do nothing’ case, some asset replacement works would be required to ensure SBY Zone Substation can continue to be operated in a safe and serviceable manner. The total cost of these works is approximately $2.3 million (real $2014). This work would be required if a suitable non-network option is found, so it should be taken into consideration by proponents of non-network solutions.

In addition to the cost of asset replacement works, the Base Case includes a significant amount of expected unserved energy. Using the VCR described in section 4.3, Jemena estimates the cost of this unserved energy to be approximately $125 million to 2024 and $378 million to 2032 in present value terms. Further details of the expected unserved energy are provided in section 6.2.

5.2 CREDIBLE NETWORK OPTIONS

5.2.1 OPTION 1 – REDEVELOP SBY ZONE SUBSTATION

Under Option 1, Jemena would augment and redevelop the SBY Zone Substation to current standards by the end of 2018 with the intent of securing the existing zone substation site for long term use.

Option 1 involves upgrading the SBY Zone Substation to comply with Jemena’s current zone substation design standards by establishing a new control building and replacing the existing outdoor 22 kV switchyard with indoor 22 kV switching. It also includes an upgrade of the 66 kV bus from a strung bus arrangement to a rigid bus arrangement and replacement of two aged 66 kV circuit breakers. The station capacity will be increased by replacing the 10 MVA transformer with a new 20/33 MVA transformer whilst rearranging the substation so that additional capacity can be accommodated in future, if required. Aged control and protection equipment will also be replaced and located in the new building. The existing asbestos clad control building will be demolished and removed. A Rapid Earth Fault Current Limiter (REFCL) will be installed.

Future works under this option may include installation of a fourth transformer, in around 2024/25, which would be the second 20/33 MVA transformer installed at SBY. At that time the two 10/16 MVA transformers would be re-arranged and connected in parallel, to operate as a single unit to closely match the two 20/33 MVA units on site. At this time, however, it is not necessary to commit to such augmentations. The need for any such work will be determined through a separate economic evaluation in the future, based on updated demand forecasts at that time. Accordingly, potential future augmentation works beyond 2020 have not been included in the economic evaluations of the options presented here.

The advantages of Option 1 include:

- There will be minimum expected unserved energy after 2018.
- With the proposed redevelopment of the SBY site, this option will provide full switching capability, thereby minimising the impact to customers of most outages. It also provides significant expansion capability, to satisfy immediate distribution feeder requirements, and spare 22 kV circuit breakers for future load growth and capacitor bank connections.
- Since the outdoor 22 kV switchgear has a history of faults due to birds and other wildlife contacting and short circuiting equipment, implementation of the new indoor 22 kV switching is expected to result in fewer unplanned outages.

A small amount of residual expected unserved energy would continue to arise beyond the completion date in 2018. At this stage, indicative capital costs of the option are estimated to be $10.2 million in present value terms. The residual unserved energy is estimated to cost a further $3.8 million in present value terms. This is substantially less than the base case unserved energy, which is estimated to cost $378 million over the period to 2032.

5.2.2 OPTION 2 - REDEVELOP SBY AND DEVELOP NEW ZONE SUBSTATION BY 2024/25

Option 2 involves redeveloping SBY, establishing a new zone substation, and vacating the existing SBY site. Under this option, Jemena would:

- Redevelop the SBY Zone Substation to current standards by the end of 2018 (as per option 1);
- Develop a new zone substation on the Bulla side of Sunbury in around 2024/25;
- Relocate 66 kV switching to a new zone substation site by 2031; and
- Demolish and handover the existing SBY site by the end of the current lease term in 2032.

In addition to the advantages of Option 1, this option allows sufficient time to plan and relocate sub-transmission lines and 66 kV switching by the end of the current lease period.

With this option implemented, the present value of residual expected unserved energy until 2032 will be $2.2 million, compared to the existing base case value of $378 million over the same period. The estimated capital cost of this option is $47.3 million, which equates to $25.7 million in present value terms. In estimating the capital cost, it is assumed that new zone substation will be established on the Bulla side of Sunbury. The sub-transmission and 66 kV switching will be relocated to the same site of the new zone substation at Bulla.

5.2.3 OPTION 3 – DEVELOP NEW ZONE SUBSTATION BY 2018

Option 3 involves establishing a new zone substation by the end of 2018 with the intent of demolishing and vacating the existing SBY Zone Substation site by the end of the current lease period i.e. 2032.

As part of this option, minimum works outlined under the base case in Section 5.1 will be performed along with the replacement of the plant nearing the end of its design life. A new two transformer zone substation on the Bulla side of Sunbury will be established by the end of 2018.

Future works in this option include relocating sub-transmission lines and 66 kV switching by 2032.

The establishment of a new 66 kV line route to a Bulla site may not be possible due to uncertainty of new routes, high costs, or community issues. In that case, a new site would be developed for 66 kV switching. This site could be developed as second zone substation in future when required to meet load growth (likely to be after 2032). This zone substation would supply areas south and west of Sunbury, while the Bulla Zone Substation would supply areas north and east.

An advantage of Option 3 is that the expected unserved energy would be zero after 2018, with a relatively small exposure to unserved energy prior to project completion. In terms of disadvantages, however, it is noted that the supply reliability issues at SBY would remain.

The estimated capital cost of this option is approximately $41.3 million, which is approximately $25 million in present value terms. For the cost estimate of this option, it is assumed that the works under the Base Case (including REFCL installation) will be carried out on the existing SBY Zone Substation and the sub-transmission lines and 66 kV switching will be relocated to the Bulla Zone Substation.

5.3 PREFERRED NETWORK OPTION

The table below summarises the indicative cost estimates for the Base Case and each of the three credible network options.

Table 5–1: Indicative costs of network options

Option	Present value indicative cost ($M, 2014 real)	
	Capital	Expected unserved energy to 2032
Base Case	2.3	378
Option 1 – Redevelop SBY Zone Substation by the end of 2018	10.2	3.8
Option 2 - Redevelop SBY and develop new zone substation by 2024/25	25.7	2.2
Option 3 - Develop new zone substation by 2018	25	0

On the basis of the indicative cost estimates presented above, Jemena has identified Option 1 as the preferred option, on the assumption that access to the SBY site is secured.

Non-network proponents should assume that in the absence of a viable non-network solution, the preferred network option will proceed.

5.4 NON-CREDIBLE NETWORK OPTIONS

A number of shorter term network options were considered but assessed as non-credible because the associated costs are too high, they do not sufficiently mitigate the SBY supply capacity constraint and/or they do not address the underlying supply reliability issue. The network options that were assessed as non-credible included:

- Transferring load to nearby COO or SHM Zone Substations;
- Improving SBY transformer load sharing to maximise utilisation of transformer capacity by:
  - optimising transformer tappings;
  - installing cooling fans to increase the rating of the 10 MVA transformer;

  - splitting the 22 kV bus and reconfiguring 22 kV feeders; and

- Loading SBY transformers to their cyclic ratings under system normal conditions.

5.5 POTENTIAL CREDIBLE NON-NETWORK OPTIONS

5.5.1 EMBEDDED GENERATION

Embedded generation can be an alternative for the alleviation of network inadequacies and constraints, thereby deferring the need for major substation or line augmentation projects. In order to defer any network augmentation projects, the embedded generation would need to be connected to, and supply into, the 22 kV distribution network where constraints exist.

Possible embedded generators could include the following types:

- Gas turbine power stations;
- Co-generation from industrial processes; and
- Generation using renewable energy (e.g. land-fill, wind turbine, solar, etc.).

At the time of preparing this non-network options report there are no known proponents for connection of embedded generation to the JEN network in the Sunbury or surrounding areas. Embedded generation proponents are encouraged to apply or express their interest to Jemena. Contact details and timeframes are set out in Section 7.

From a network constraint perspective, embedded generation could potentially address the SBY Zone Substation supply capacity constraint but will not mitigate the supply reliability issues associated with SBY Zone Substation.

5.5.2 DEMAND MANAGEMENT

Demand management schemes have the potential to reduce peak demand on the electricity network and thereby defer the requirement for network augmentation. This is achieved by customers shifting their usage to off-peak periods or reducing their overall consumption by using energy efficient appliances and reducing energy wastage.

Demand management schemes could include:

- peak load usage shifting or lopping incentives; and
- interruptible loads being offered in return for a reduced electricity price.

If such schemes were established, their effectiveness would depend on the extent of customer uptake. At the time of preparing this non-network options report there are no known proponents of demand management on the JEN network in Sunbury and surrounding areas. Jemena would welcome proposals from demand management proponents. Contact details and timeframes for submitting a response to this non-network options report are set out in Section 7.

From a network constraint perspective, demand management could potentially address the SBY supply capacity constraint but will not mitigate the underlying supply reliability issues associated with SBY zone substation.

6. TECHNICAL CHARACTERISTICS OF NON-NETWORK OPTIONS

This section sets out the technical characteristics of our needs[4]. This information is provided to enable proponents of non-network solutions to understand the identified need, and to tailor their proposals accordingly.

Jemena wants to explore all potential non-network solutions with proponents in order to deliver the lowest-cost solution to our customers. We recognise that proponents may require additional specific information to develop their proposals. Accordingly, we encourage proponents to contact us as early as possible, to ensure that we can provide all the specific information that a proponent may require.

Further details on how to contact us are set out in Section 7.1.

6.1 SIZE AND LOCATION OF LOAD REDUCTION OR ADDITIONAL SUPPLY

Table 6-1 below outlines the estimated amount of load reduction, or additional generation in the SBY supply area that would alleviate the supply capacity constraint. It is noted that a non-network solution cannot address the underlying supply reliability issues associated with the SBY zone substation.

Nevertheless, a non-network option may be preferred even though it cannot fully address the identified need. In this sense, it is no different from some network options, which may not eliminate entirely the expected unserved energy. Jemena will consider each option on its merits, having regard to its expected performance in terms of addressing our needs, and the overall costs to our customers.

Table 6-1: Peak demand offsets required from non-network solutions

Year	Load at risk (MVA)
2015	3.6
2016	5.4
2017	8.2
2018	10.8
2019	13.8
2020	15.9
2021	17.5
2022	19.3
2023	21.1
2024	22.7

The above table is based on N-1 conditions and demand at 50% POE.

As noted in Section 5.5, in order to defer any network augmentation projects, embedded generation would need to be connected to, and supply into, the 22 kV distribution network where constraints exist. Information on the

4 In accordance with Clause 5.17.4(e)(4) of the Rules.

SBY supply area is provided in Sections 2.1 and 2.2. Jemena would be pleased to provide further information to a non-network proponent to assist in developing a non-network solution.

6.2 POTENTIAL DEFERRED AUGMENTATION CHARGE

As explained in section 5.1, the Base Case would result in a significant amount of unserved energy. The impact of the network limitations under the Base Case (in which no action is taken to augment capacity) is shown in Table 6-2.

Table 6-2: Limitation impact under base case

Year	Energy at Risk (MWh) Annual	Hours at Risk (h)	Expected Unserved Energy (MWh)	Cost of Expected Unserved Energy ($'000)
2015	48.3	19.5	2.0	$79
2016	101.5	34.6	6.8	$262
2017	253.5	66.8	31.7	$1,218
2018	608.0	178.8	94.6	$3,633
2019	1474.0	434.6	214.3	$8,230
2020	2353.5	605.8	344.1	$13,215
2021	3324.3	740.0	517.9	$19,888
2022	4569.2	886.8	795.3	$30,538
2023	6322.7	1075.7	1267.5	$48,674
2024	8459.2	1301.1	1910.8	$73,374

The table shows the total expected benefit that will be achieved if all energy at risk is eliminated. If zero load growth is assumed from 2024 onwards, the present value of expected unserved energy to 2024 is $125 million and to 2032 is $378 million, using a discount rate referred to in section 4.4.

In order to be selected as the preferred solution, a non-network solution would need to maximise the net benefits compared to other available options, including the preferred network solution. As already noted in Section 5.2.1, the augmentation capital costs for Option 1 are approximately $10.2 million, which equates to an annualised total charge of approximately $1 million per annum. On the basis that a non-network option delivers exactly the same performance as the preferred network solution, the deferred costs of $1 million per annum represent the upper bound that would be available as an annualised network support payment.

As already noted, however, a non-network option alone would not resolve some of the underlying issues at SBY. It follows that a non-network option would need to be delivered at costs below those of the preferred network option, if a non-network option were to maximise net benefits. Specifically, the cost saving compared to the preferred network option would need to compensate for the reduced benefits provided by the non-network solution compared to the preferred network option.

6.3 TIMING OF REQUIREMENTS

The data in Table 6-2 indicates that the potential value provided by a non-network option increases markedly from 2016 onwards. As noted in Sections 5.2.1 and 5.3, the preferred network option is to augment and redevelop the SBY Zone Substation by the end of 2018, with the intent of securing the existing zone substation site for long term use. The option involves limited unserved energy beyond that date.

Ideally, a non-network option would be operational from November 2017 or November 2018. Although a later commissioning date would be considered, Jemena would be concerned if the proposed timing of a non-network solution extended beyond that of the preferred network option, which, as noted above, is scheduled for the end of 2018.

6.4 OPERATING PROFILE

The annual profile of load supplied from SBY is shown in Figure 6-1 below.

Figure 6-1: Sunbury Zone Substation annual load profile

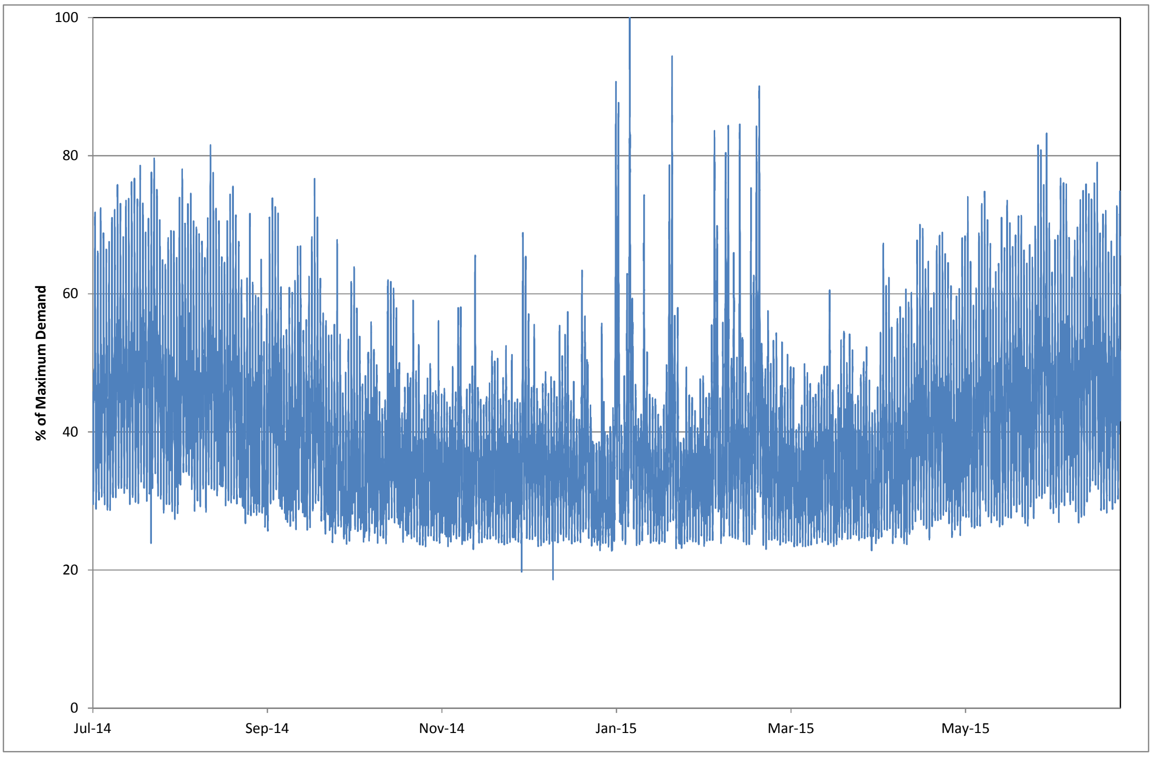
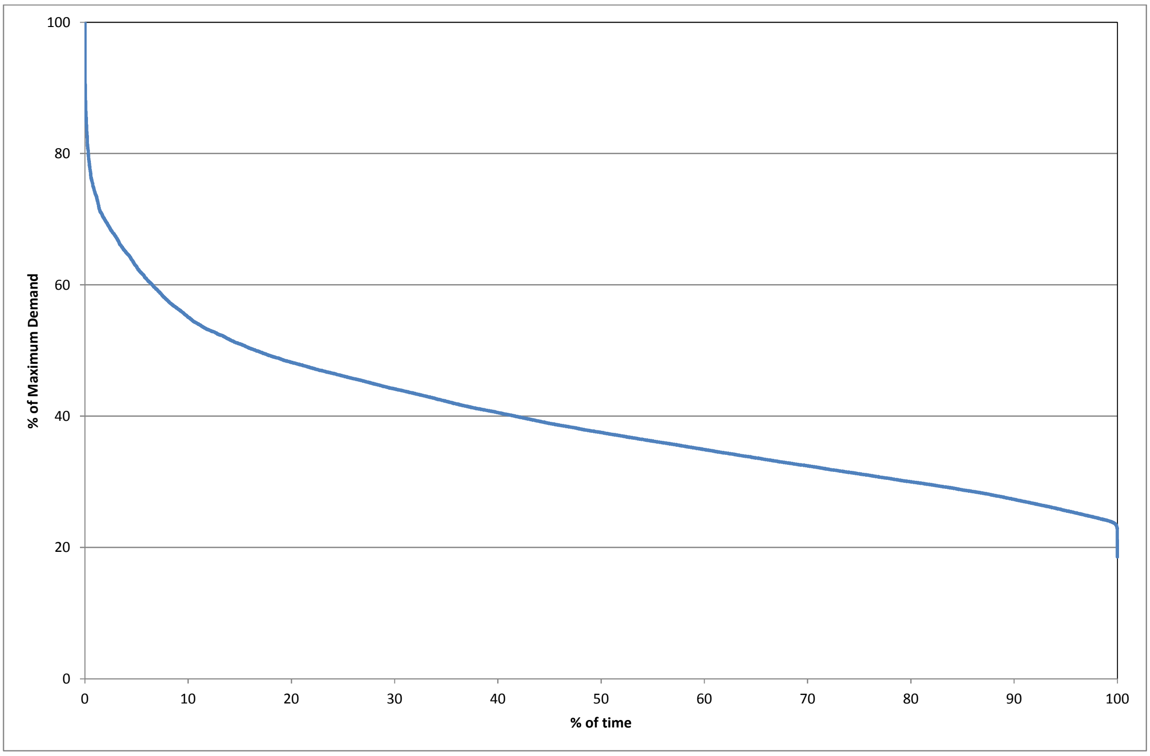


Figure 6-1 shows that peak load on the station occurs over the Summer period from October to March. The load at risk is concentrated in this period, so a non-network solution would be required to be available over that period in order to reduce demand or increase local generation to avoid supply interruptions. Table 6-2 in Section 6.2 shows that the hours per year that load is at risk ranges from 34.6]in 2016 up to 1301.1 in 2024.

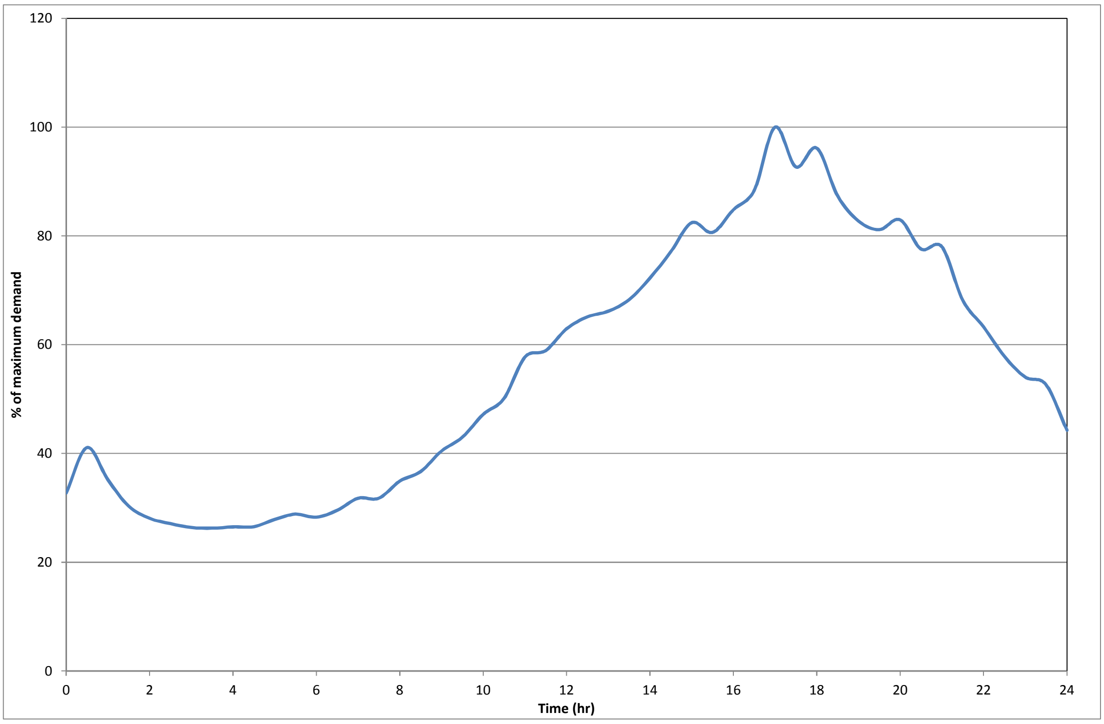
The load duration curve for SBY 2014-15 is shown in Figure 6-2 below.

Figure 6-2: Sunbury load duration curve for 2014-15



The load profile on the day of Summer maximum demand, shown in Figure 6-3 below, indicates that the peak demand at SBY occurs between 4.00 pm and 8:00 pm.

Figure 6-3: Load profile on day of summer maximum demand at SBY



Ideally, a non-network solution would eliminate the load at risk at SBY over the planning period. This level of performance would mean that the non-network option is comparable with the preferred network solution in terms of addressing the capacity constraints. However, a non-network solution may still be preferred even if it results in higher levels of unserved energy compared to the preferred network option. As already noted, Jemena will select that option that maximises the net benefit.

Jemena would be pleased to discuss this issue further with non-network proponents. Specifically, we would be pleased to discuss any proposed cost/performance combination that proponents considered to be more cost effective than the preferred network solution.

6.5 POWER SYSTEM SECURITY AND RELIABILITY

In order to substitute for traditional 'poles and wires' augmentation, proposed non-network options must be capable of reliably meeting the electricity demand under a range of conditions. As already noted, however, a potentially viable non-network option would not necessarily be required to provide a level of reliability that is identical to that provided by the preferred network solution. Rather, the value of a non-network option will reflect the reduction in expected unserved energy that the option is capable of delivering relative to the network option. The preferred network or non-network option is the one that maximises net benefits.

If the non-network option is a generator connected to Jemena's distribution network, the generator will be required to comply with the standards set out in our Embedded Generation Guidelines, which are available at:

https://jemena.com.au/about/document-centre/electrcitiy/embedded-generation-guidelines

The guidelines detail important requirements relating to:

- embedded generation access (connection) standards;
- embedded generation testing, commissioning and maintenance requirements; and
- operational constraints and standards.

Proponents of embedded generation solutions should familiarise themselves with these requirements.

6.6 FAULT LEVEL CONTRIBUTION

The installation of an embedded generator may raise the fault level of the network to which it is connected. It is important to ascertain that the resulting fault levels are not raised above the existing acceptable rated fault levels for circuit breakers, conductors, any auxiliary plant and fittings including earth grid, Distribution Code or design limits. We may need to carry out system fault level studies to assess these matters.

Under section 7.8 of the Victorian Electricity Distribution Code, an embedded generator is required to design and operate its embedded generating unit so that it does not cause fault levels in the distribution system to exceed the levels specified in Table 6-3 below. The existing fault levels at SBY are specified in Table 6–4.

Table 6-3: Victorian Electricity Distribution Code fault levels

Voltage Level kV	System Fault Level MVA	Short Circuit Level kA
66	2500	21.9
22	500	13.1
11	350	18.4
6.6	250	21.9
<1	36	50.0

Table 6–4: SBY Zone Substation fault levels

Voltage level (kV)	Fault levels (kA)	
	3 phase	1 phase to ground
66	6.9	3.8
22	6.3	1.6

7. SUBMISSIONS FROM INTERESTED PARTIES

7.1 INVITATION FOR SUBMISSIONS

Jemena seeks submissions from interested parties, including proponents of non-network solutions.

As noted already, we are interested in exploring all potential non-network solutions with proponents. We recognise that some proponents may require information in addition to that provided in this report. If you do need further information, please contact us as early as possible, to ensure that sufficient time is available to fully assess feasible network and non-network potential solutions. It should be noted that parts of the network exhibit volatile load growth, usually driven by economic and demographic factors that are difficult to foresee and model. It is essential that alternatives to network solutions are presented by proponents in sufficient time to allow for their thorough evaluation, planning and implementation.

All submissions and enquiries should be directed to:

Ashley Lloyd
Network Capacity Planning & Assessment Manager
Email: PlanningRequest@jemena.com.au
Phone: (03) 9173 8279

Submissions should be lodged with us on or before 29 January 2016.

All submissions will be published on Jemena's website. If you do not wish to have your submission published, please indicate this clearly.

7.2 INFORMATION FROM NON-NETWORK PROPONENTS

To assist in the assessment of non-network solutions, proponents are invited to make a detailed submission. That submission should be informed by earlier discussions with us (arranged through the contact officer noted above), and should include the following details about the proposal:

1. Proponent name and contact details;
2. Overview of the extent to which the proposal addresses the identified need;
3. A technical description of the proposal, including:

- location;
- size of the load reduction or additional supply;
- electrical layout schematics;
- network connection requirements, if needed;
- contribution to power system security or reliability;
- contribution to power system fault levels, load flows and stability studies (if applicable);
- the operating profile;
- reliability;

- how each of these matters is consistent with the applicable technical standards;

4. Timing of delivery of solution and its estimated lifespan;
5. Proposed operational and contractual commitments, including financier commitments;
6. Planning application information, where required;
7. Salvage and removal costs; and
8. An evaluation of potential risks associated with the proposal, including a comparison with the risks associated with the preferred network augmentation option, and any actions that can be taken to mitigate these risks. This assessment should address the risk of not meeting the demand requirement and the compensation arrangements that would apply in such circumstances.

We will review each non-network option and we may seek further information from the non-network proponent to better understand the design of the proposed solution and its implications on the network and other network users.

7.3 NEXT STEPS

As outlined in Section 1, this report is being prepared under the RIT-D consultation procedures, to help us and interested parties identify potential non-network options to address the identified need in the Sunbury and Diggers Rest area.

Following our consideration of submissions on this non-network options report, we will proceed to prepare a Draft Project Assessment Report. That report will present a detailed assessment of all options to address the identified need, plus a summary of, and commentary on the submissions to this report. The Draft Project Assessment Report will apply the latest available information on demand forecasts, VCR estimates and project cost estimates.

We intend to publish the Draft Project Assessment Report by 30 June 2016. Further consultation, in accordance with the RIT-D process set out in the Rules will then proceed.