Reasonableness Test RT 005/13

Dorrien and Nuriootpa 33/11kV Substations

N-1 Capacity Constraint

SA Power Networks

www.sapowernetworks.com.au

DISCLAIMER

The purpose of this document is to inform customers, Interested Parties, Registered Participants and solution providers of the outcome of the application of the Reasonableness Test to the capacity constraint occurring at Dorrien and Nuriootpa Substations. This document is not intended to be used for other purposes, such as making decisions to invest in generation, transmission or distribution capacity.

The Reasonableness Test has been prepared with consideration for pertinent information provided by a number of third parties. It contains assumptions regarding, amongst other things, economic growth and load forecasts that, by their nature, may or may not prove to be correct. SA Power Networks advises that anyone proposing to use this information should verify its reliability, accuracy and completeness before committing to any course of action. SA Power Networks makes no warranties or representations as to its reliability, accuracy and completeness and SA Power Networks specifically disclaims any liability or responsibility for any errors or omissions or not.

Whilst care was taken in the preparation of the information in this paper, and it is provided in good faith, SA Power Networks accepts no responsibility or liability for any loss or damage that may be incurred by any person acting in reliance on this information or assumptions drawn from it.

GLOSSARY OF TERMS

Term	Meaning
Contingency Condition (N-1)	The term used to describe the state of the Distribution Network when any one piece of plant (N-1) is out of service, with the rest of the Network remaining intact.
Connection Point	A substation shared with ElectraNet, at which electrical power is injected from the ElectraNet Transmission Network into SA Power Networks' Distribution Network.
Distribution System	Shall have the meaning as defined within Chapter 10 of the National Electricity Rules.
Firm Delivery Capacity (N-1 Rating)	The maximum allowable load of a Substation under single Contingency Conditions, including any short term overload capacity.
POE	Probability of Exceedance. The 50% POE forecast (1 in 2 year event) is compared against the substation's firm delivery capacity.
PV	Photovoltaic (also known as solar cells).
Transfer Capacity	The amount of load that can be transferred to an adjacent substation via the 11kV feeder network, while still providing adequate customer voltage levels.

GUIDELINE 12 REASONABLENESS TEST

N-1 Capacity Constraints within the Central Barossa Valley

1. CURRENT SUPPLY ARRANGEMENT

Dorrien and Nuriootpa 33/11kV Substations are located in the Barossa region and are supplied from the Dorrien 132/33kV Connection Point.

Dorrien Substation contains one 12.5MVA 33/11kV transformer and supplies approximately 1800 customers via three 11kV feeders who are predominantly residential, rural and agricultural.

Nuriootpa Substation contains one 12.5MVA 33/11kV transformer and supplies approximately 2700 customers via two 11kV feeders who are predominantly residential, rural and agricultural.

There are 11kV feeder ties between Dorrien and the adjacent Nuriootpa Substation as well as Angaston Substation (to the east of Dorrien Substation).

During the 2015/16 summer under 50% PoE conditions (average summer) approximately 5.3 MVA of load can be transferred from Dorrien to these neighbouring substations via the 11kV feeder network within 4 hours. Transfer capacity is limited by the available spare capacity adjacent 11kV feeders and the requirement to maintain adequate customer voltage levels.

Dorrien Substation has a firm delivery capacity of 0 MVA. For the summer of 2015/16, the 50% PoE forecast is 10.6 MVA. Therefore, 5.3MVA of customer load is forecast to be unsupplied during a contingent event after all available load transfers have been implemented.

Nuriootpa 33/11kV Substation has a single 12.5MVA transformer with a firm delivery capacity of 0MVA. The Nuriootpa Substation 2015/16, 50% PoE forecast is 11.7 MVA with only 4.5MVA of available 11kV load transfers. Therefore, 7.2MVA of customer load is forecast to be unsupplied during a contingent event after all available load transfers have been implemented.

Angaston 33/11kV Substation has two 12.5MVA transformers with a firm delivery capacity of 15.2MVA. The Angaston Substation 2015/16, 50% PoE forecast is 19.3 MVA with 2.7MVA of available 11kV load transfers. Therefore, 1.4MVA of customer load is forecast to be unsupplied during a contingent event after all available load transfers have been implemented.

For a transformer outage at any of the above three substations the remaining unsupplied customer load from that site will be remain unsupplied until the mobile substation is deployed and connected. (typically up to 24 hours).

The area under consideration is shown on Figure 1 over page.

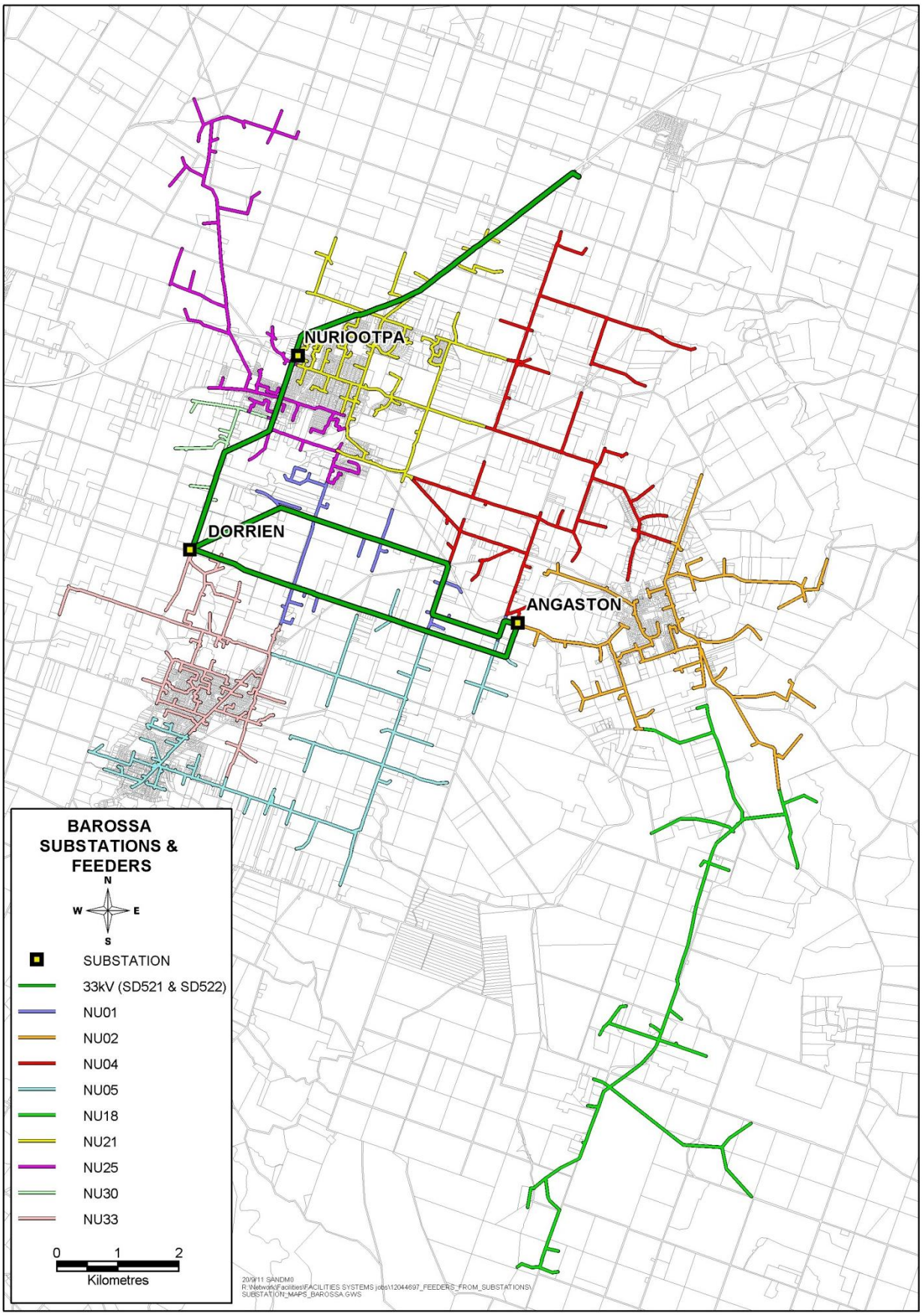

Figure 1 Locality of Dorrien Substation

2. FORECAST LOAD AND CAPACITY

2.1 Load Forecast

Total 11kV load at Dorrien Substation is forecast to grow from 9.9 MVA in 2013/14 to 14.5 MVA in 2023/24, as shown in Table 1. This growth represents the moderate 50% POE forecast (average summer) which SA Power Networks uses for contingency planning purposes. Nuriootpa Substation load is forecast to grow at a slower rate to that at Dorrien and is included below. The forecast takes into account all known existing or committed demand management programmes, and also includes an adjustment for the presence of any embedded generation including roof top PV installed. Dorrien Substation power factor at peak times is 0.97, Nuriootpa Substation power factor is 0.96 at peak times.

Table 1 Forecast load growths

Summer Year	Dorrien Substation			Nuriootpa Substation		
	MVA	MW	MVAr	MVA	MW	MVAr
2013/14	9.9	9.6	2.5	11.3	10.8	3.3
2014/15	10.2	9.9	2.5	11.4	10.9	3.3
2015/16	10.6	10.3	2.6	11.7	11.2	3.4
2016/17	11.0	10.7	2.7	12.1	11.6	3.5
2017/18	11.5	11.1	2.9	12.5	11.9	3.6
2018/19	11.9	11.6	3.1	12.8	12.3	3.8
2019/20	12.4	12.0	3.1	13.2	12.7	3.9
2020/21	12.9	12.5	3.2	13.6	13.0	4.0
2021/22	13.4	13.0	3.3	14.1	13.4	4.1
2022/23	14.0	13.5	3.7	14.5	13.9	4.2
2023/24	14.5	14.1	3.8	14.9	14.3	4.4

SA Power Networks has no committed distribution or sub transmission augmentations in the Dorrien/Nuriootpa area.

There is no known significant embedded generation permanently connected to Dorrien and Nuriootpa Substations other than domestic roof top PV, the impact of which is included in the above forecast.

SA Power Networks is not aware of any existing or committed embedded generation augmentations that will potentially impact on the distribution network that services Dorrien and Nuriootpa Substations.

2.2 Pattern of Use

Peak electricity demand at Dorrien and Nuriootpa Substations occurs during the late summer months, predominantly as a result of air-conditioning load combined with grape harvesting.

The peak load profile from the 12th March 2013 is typical of the load on the substation during peak periods. It shows some sign of PV penetration with a fairly late peak at approximately 18:00 followed by a drop off from 20:00. In numbers, load is above 85% of peak between 14:30 and 20:30 and above 95% of peak between 16:30 and 19:30.

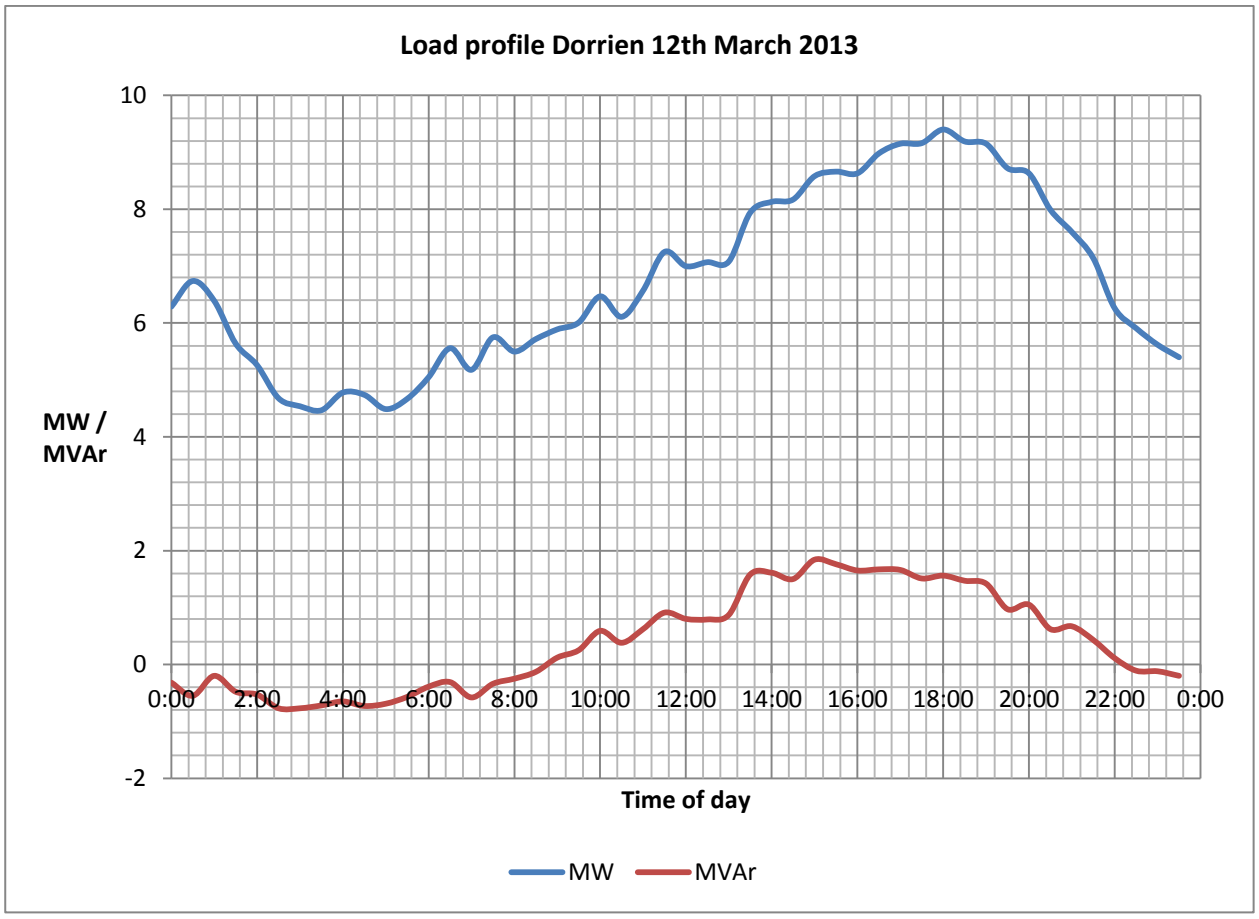

Figure 2 Load profile Dorrien

In terms of the annual spread, loads in the Dorrien and Nuriootpa area are fairly typical of residential, rural and agricutural load including grape harvesting, in particular the load shows:

- A sharp peak occuring on a few hot days a year and a quite low average for the rest of the time.
- Loads are in excess of 95% of peak for approximately 8 hours a year
- Loads are in excess of 85% of peak for approximately 52 hours a year.
- Average load is approximately 42% of the recorded peak.

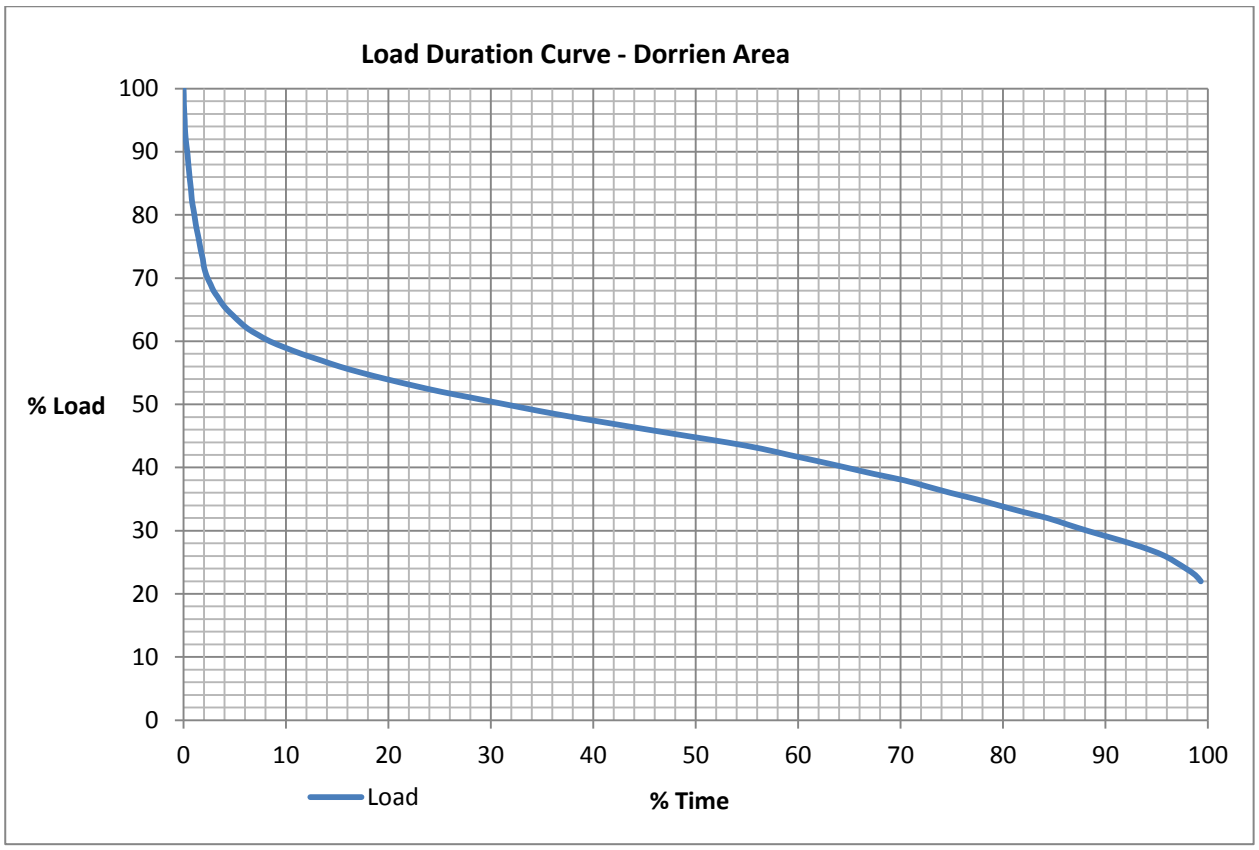

Figure 3 Load duration curve - Dorrien area

2.3 System Limitations

Following the loss of the single 33/11kV transformer at either Dorrien or Nuriootpa substation, not all load can be transferred to other substations within 4 hours under 50% POE conditions. In summer 2015-16 peak load at risk is 5.3MVA at Dorrien and 7.2MVA at Nuriootpa and there is an estimated 2,500 hours annually in which some load is at risk. By summer 2019-20 load at risk has risen to 8.5 MVA at Dorrien and 9.8MVA at Nuriootpa.

Following transfers to adjacent substations, the load at risk will be unsupplied until a mobile substation can be installed (typically up to 24 hours) or the transformer repaired or replaced (typically up 7 days).

The identified need is to reduce the load at risk at Dorrien or Nuriootpa substation following a transformer outage at either substation.

3. NETWORK UPGRADE

Network options that have been investigated to resolve these potential overloads include the following:

Option 1:

- Upgrade Nuriootpa Substation with second 33/11kV transformer,
- Upgrade 33kV line between Dorrien Substation and Nuriootpa Substation, and
- Transfer load from Angaston Substation and Dorrien Substation to Nuriootpa Substation.

Option 2:

- Upgrade Dorrien Substation with second 33/11kV transformer, and
- Transfer load from Nuriootpa Substation and Angaston Substation to Dorrien Substation.

The preferred solution, when the net present value, timing and effectiveness of related upgrade projects is considered, is to upgrade Dorrien 33/11kV Substation with second 33/11kV transformer (Option 2). The indicative cost for this project is in the order of $5,500,000. This project is planned for completion in 2015.

4. DEMAND MANAGEMENT ANALYSIS

4.1 Required Demand Management Characteristics

For a demand management option to be credible it must be capable of:

- Reducing the load at risk at Dorrien and Nuriootpa substations.

Given the substantial hours at risk this load reduction must be available all year and include both day and evening hours. It may operate post fault in conjunction with manual line switching operations.

Table 2 Load reduction required (MVA)

Year	Dorrien	Nuriootpa
	MVA required	MVA required
2014	4.7	6.8
2015	5.3	7.2
2016	5.9	7.8
2017	6.5	8.3
2018	7.1	8.7
2019	7.8	9.3
2020	8.5	9.8
2021	9.0	10.4
2022	9.8	10.9

4.2 Demand Management Value

The following table indicates how much can be spent in year 1 to achieve a 1, 2 or 3 year deferral expressed both as an overall cost and as $ per kVA. The minimum and maximum amounts are derived by using different assumptions on the cost of capital from a minimum of 8.98% to 12.5%. The stated benefits also include an allowance of $50k per annum to cover our administrative costs. Note that these figures are indicative only and that any credible DM solution proposed will be evaluated against the preferred network solution in a full RIT-D evaluation. Details of how this is done can be obtained from the Demand Side Engagement Strategy document found on our website.

Table 3 $ per kVA available for Demand Management

Deferral benefits	Total Available Benefit $,000's (min)	Total Available benefit $,000's (max)	$ available per kVA (Min)	$ available per kVA (Max)
1 year Deferral	$433	$590	$60	$82
2 year Deferral	$876	$1,159	$112	$149
3 year Deferral	$1,283	$1,665	$155	$201

4.3 Demand Management Options Considered

Various Demand Management (DM) technologies were considered to determine their viability to assist in reducing the demand in the constrained area. These DM options were evaluated for both technical feasibility as well as cost effectiveness.

4.3.a Major Customer Load Curtailment

Establish contracts with customers to curtail load during network contingencies. This option is not considered viable as the major customers supplied from Dorrien and Nuriootpa Substations are wine industry related therefore load curtailment during the peak load wine vintage period is not considered practical. Other non wine industry major customers supplied from the nearby Angaston Substation were also considered for such a scheme. Given that Dorrien Substation will have 5.3MVA and Nuriootpa Substation 7.2MVA of load at risk in 2015/2016, major customer load curtailments of this magnitude are not considered practical.

4.3.b Standby diesel generators

Establish contracts with customers who have standby diesel generators on their premises and utilise the generators at peak load times or install peak lopping generators to reduce load at peak times. This option is not viable as there are not enough large customers with standby generators within the region to make this option feasible.

4.3.c Install new diesel generation

Recent experience indicates that the $ per kVA value available is too small to support a peaking plant, even if one could be built in the timeframe required.

4.3.d Install power factor correction

This option is not technically feasible as there is already existing power factor correction at Nuriootpa, Angaston and Dorrien with further power factor correction having little impact on load.

4.3.e Retrofit commercial lighting with efficient lighting.

This option relies upon the ability to upgrade existing commercial fluorescent lighting to T5 lighting. Based on the upgrade of an existing 400W fluorescent bank with a 2x 80W efficient bank to provide the equivalent lumen output, the demand saving per bank is 240W.

The estimated cost for this option is $2,500/kVA. Significant disruption to the customer while the retrofit is carried out can be expected, which may influence the number of willing participants. It is highly unlikely that sufficient volume could be achieved to make a significant difference as most commercial load in the area is supplied by the Morphettville substation.

4.3.f Peak load control – direct load control

Direct load control technology may be available where tripping multiple small air conditioning units supplied from a single distribution transformer can be performed. Recent experiences have shown the costs of such solutions to range from $300 to $800/kVA. Given the size of the constraint it is highly unlikely that sufficient volume would be available to make a significant difference in the size of constraint.

4.3.g Peak load control – curtailable load

This involves establishing a contract with one or more large customer's requiring them to reduce their load by either turning off the power supply to part of their business or shifting load to "off peak" times. Practically, there are no suitable customers with a load large enough to individually have a material impact on the network load for this option to be viable.

4.3.h Residential compact fluorescent lamp (CFL) program

This option was deemed not relevant due to peak load conditions occurring in daylight hours. Load contribution from residential housing lighting during daylight hours is believed to be minimal.

4.3.i Thermal storage systems

Installation of this form of storage system at a suitable site in a previous trial revealed a saving in load in the order of 150kVA. Smaller scale installations have also been trialled and are still very much in the development stage. However, the expected cost of this size of installation ranges from $1,000-1,600/kVA, which is much more expensive than the $ per kVA available.

4.3.j Energy Storage

Use of energy storage technology such as flow batteries is typically in the order of $6000 per kVA, which is significantly more than the available amount.

5. CONCLUSION

Based on the Demand Management options considered when compared to the preferred network solution, it is not possible that sufficient Demand Management measures could be implemented to achieve the demand reduction required to make project deferral technically and economically viable.

The constraint on the Dorrien and Nuriootpa substations has therefore failed the Reasonableness Test and a Request for Proposal (RFP) will not be issued.