Reasonableness Test RT 008/13

Eastern Hills

Capacity Constraint

SA Power Networks

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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

Eastern Hills Capacity Constraint

1. CURRENT SUPPLY ARRANGEMENT

Eastern Hills Network

Uraidla 66/33kV Substation is located near the township of Uraidla and is supplied from the Eastern Hills 66kV sub-transmission system.

Uraidla Substation contains one 25MVA 66/33kV transformer, and two 6.25MVA 66/11kV transformers. The Uraidla 66/33kV transformer supplies approximately 6405 customers via one 33kV feeder who are predominantly residential.

There are limited 33kV feeder ties to the adjacent Balhannah Substation to the East of Uraidla Substation. During the 2014/15 summer under 50% PoE conditions approximately 5.7 MVA of load can be transferred to the neighbouring substation via the 33kV feeder network within 4 hours. Transfer capacity is limited by the available spare capacity at adjacent 33kV feeders and the requirement to maintain adequate customer voltage levels.

Uraidla 66/33kV Substation has a firm delivery capacity of 0 MVA. For the summer of 2014/15, the 50% PoE forecast is 15.2 MVA. 9.5 MVA of customer load is forecast to be unsupplied during a contingent event after all available load transfers have been implemented.

The pending capacity limits of the Eastern Hills 33kV and 66kV lines under normal and contingent conditions are also considered as part of the Reasonableness Test and the selection of the preferred solution.

The area under consideration is shown on Figure 1 below.

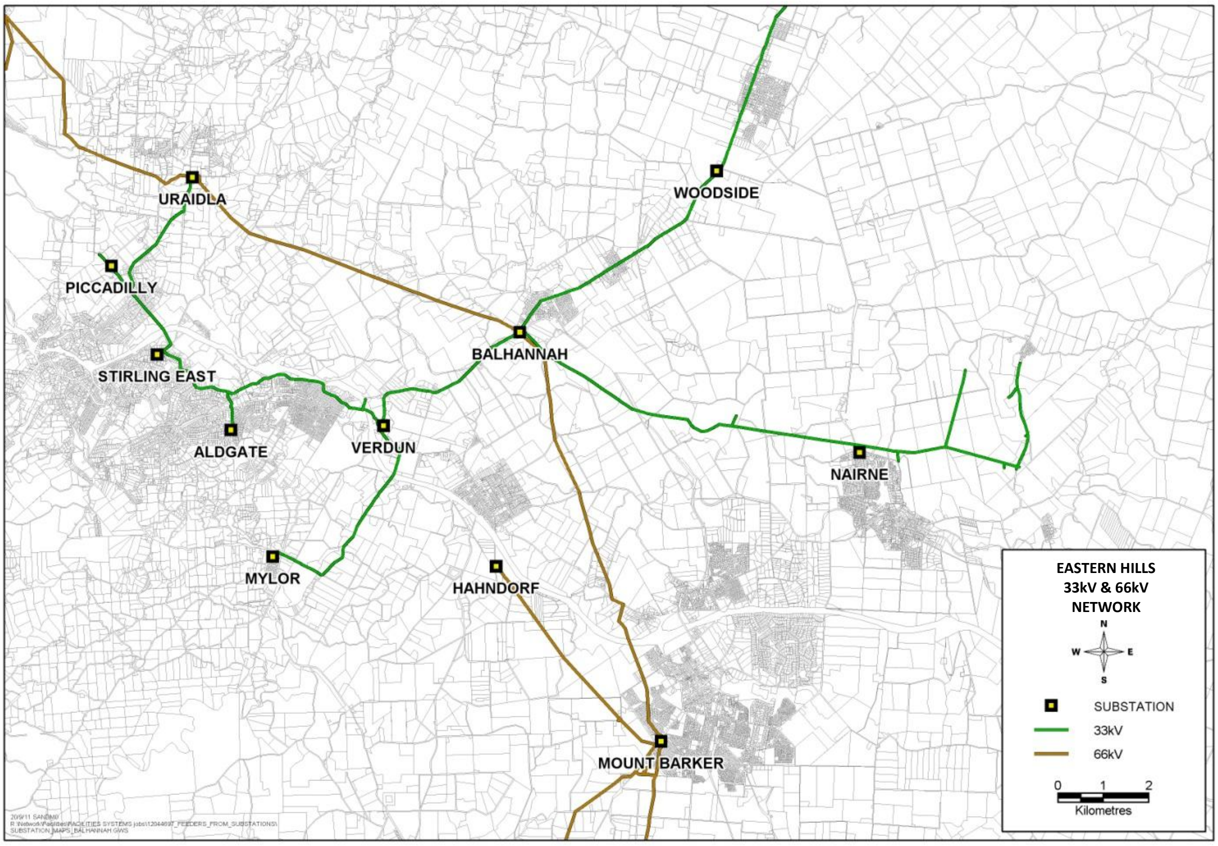

Figure 1 Eastern Hills Network

1.1 Review of Reasonableness Test RT 007/11

A Reasonableness Test RT 007/11 Balhannah and Uraidla 66/33kV substations was published in November 2011, advising that the preferred option to the Eastern Hills forecasted constraints was an upgrade of the Hahndorf Substation and the construction of a 33kV line into the existing 33kV network (designed for future use as a 66kV).

This solution is now being reviewed in this document, due to the significant increase in cost of the 33kV line works following detailed design, to determine if the Hahndorf solution is still the preferred option.

The measured changes in customer demand since 2011 have also been included in this evaluation. The impact of these changes have reduced the benefits of some of the solutions.

2. FORECAST LOAD AND CAPACITY

2.1 Load Forecast

Total 33kV load at Uraidla Substation is forecast to grow at an average rate of 1.9% per annum, which sees the load increase from 15.2 MVA in 2013/14 to 16.1 MVA in 2023/24, as shown in Table 1. This growth represents the moderate 50% POE forecast which SA Power Networks uses for contingency planning purposes. 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. Power factor at peak times is 0.95.

Table 1 Forecast load growth at Uraidla Substation

Summer Year	MVA	MW	MVAr
2013/14	15.2	14.4	4.7
2014/15	15.2	14.4	4.7
2015/16	15.3	14.5	4.8
2016/17	15.4	14.6	4.8
2017/18	15.5	14.7	4.8
2018/19	15.6	14.8	4.9
2019/20	15.7	14.9	4.9
2020/21	15.8	15.0	4.9
2021/22	15.9	15.1	5.0
2022/23	16.0	15.2	5.0
2023/24	16.1	15.3	5.0

SA Power Networks has no committed distribution or sub transmission augmentations in the Uraidla area.

There is no known significant embedded generation permanently connected to Uraidla Substation 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 Uraidla Substation.

2.2 Pattern of Use

Peak electricity demand at Uraidla Substation occurs for short periods during both winter and summer, predominantly as a result of electric heating and cooling loads.

The peak load profile from the 18th February 2013 is an example of a typical summer load peak. It shows a sharp peak at approximately 19:00 followed by a sharp drop off from 20:00. In numbers, load is above 85% of peak between 17:00 and 20:00 and above 95% of peak between 18:00 and 19:00.

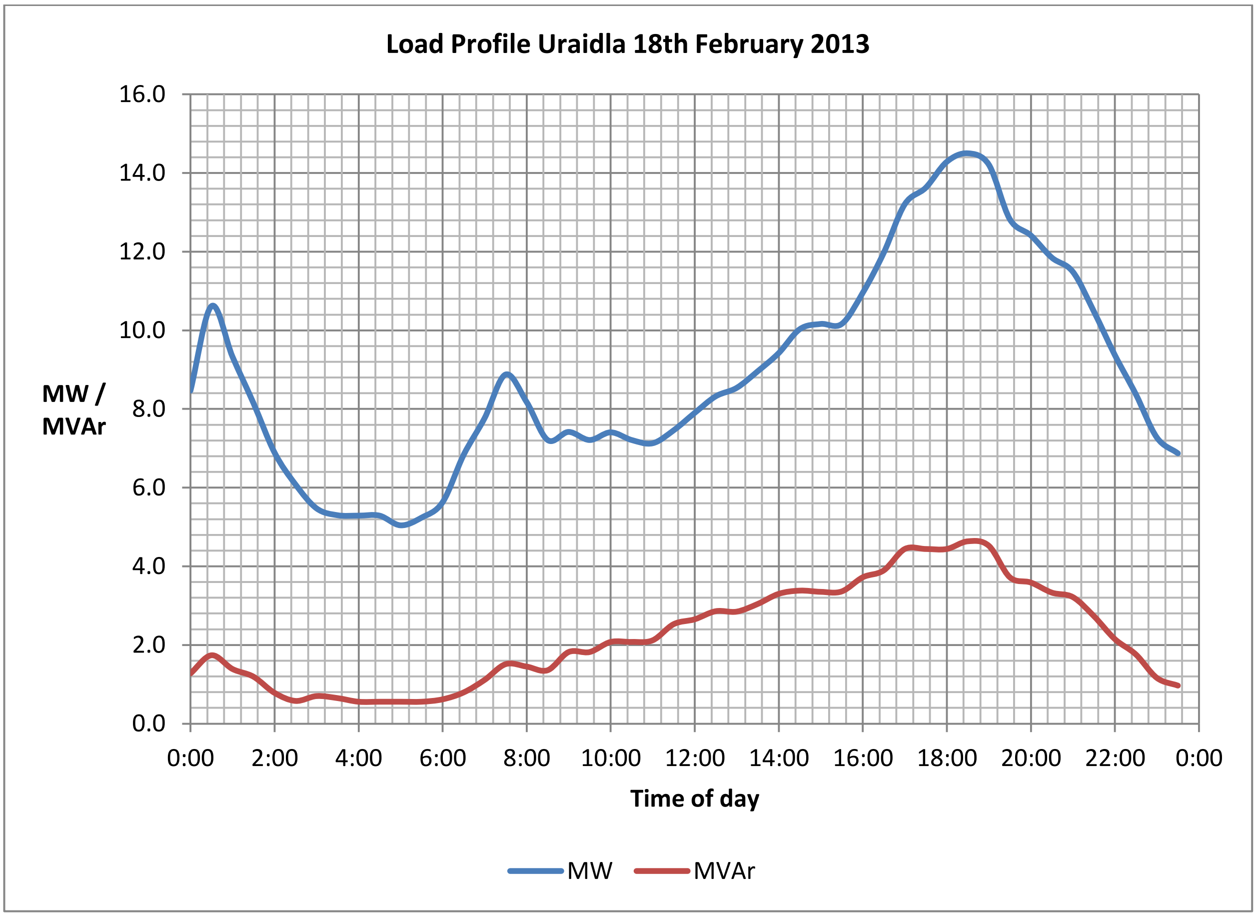

Figure 2 Load profile Uraidla

In terms of the annual spread, loads in the Uraidla area are fairly typical of residential high PV loads, in particular the load shows:

- Sharp peaks during winter when temperatures are cold, as well as during summer heat wave events, compared with a moderate yearly average.
- Loads are in excess of 95% of peak for approximately 6 hours a year
- Loads are in excess of 85% of peak for approximately 115 hours a year.
- Average load is approximately 42% of peak.

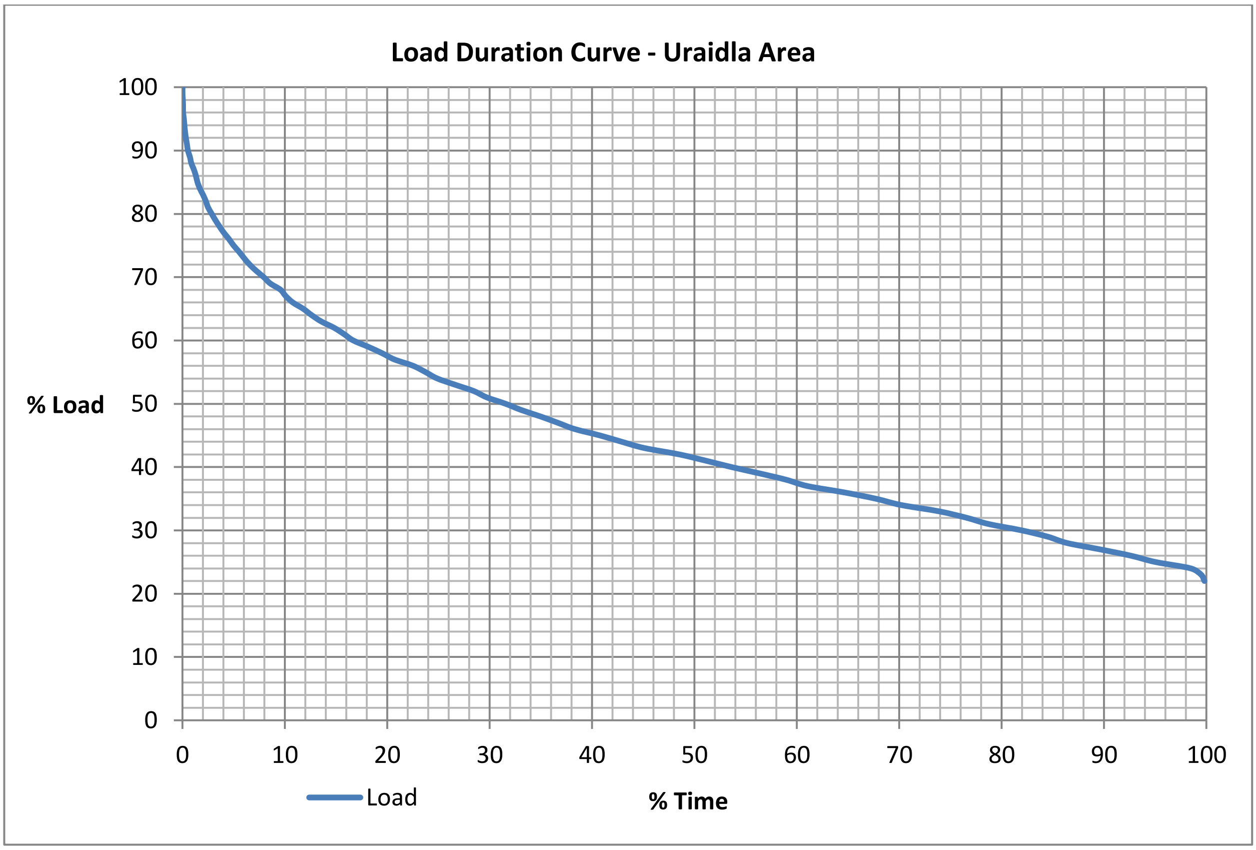

Figure 3 Load duration curve - Uraidla area

2.3 System Limitations

Following the loss of the single 66/33kV transformer, minimal load at Uraidla substation can be transferred to other substations under 50% POE conditions. In summer 2014-15 peak load at risk is 9.5 MVA and there is some load at risk all year. By summer 2019-20 load at risk has risen to 10.4 MVA.

All other forecasted network limitations in the next 10 years were also considered in evaluating the cost and benefits of each solution option, such as the pending overload of the Mount Barker to Balhannah 66kV line, the pending overload of the Uraidla to Piccadilly 33kV line and the time to restore supple after failure of any of the 66kV and 33kV lines supplying the Eastern Hills.

The identified need is to reduce the load at risk at Uraidla Substation following a transformer outage.

3. NETWORK UPGRADE

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

Option 1:

- Upgrade the Hahndorf Substation by installing a 66/33kV transformer and constructing a new 33kV line to Verdun;

Option 2:

- Upgrade the Uraidla Substation with a second 66/33kV transformer; and

Option 3:

- Upgrade the 3rd 66/33kV transformer at the nearby Balhannah Substation.

The preferred solution, when the net present value, timing and effectiveness of related upgrade projects is considered, is to upgrade Uraidla Substation with a second 66/33kV transformer (Option 2). The indicative cost for this project is in the order of $6,000,000. This project is planned for completion in November 2014.

The NPV analysis includes the future projects required in the next 10 years to meet forecasted Eastern Hills constraints (e.g. 33kV and 66kV lines).

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 Uraidla 66/33kV Substation

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	MVA required
2014	9.4
2015	9.5
2016	9.7
2017	9.8
2018	10.0
2019	10.2
2020	10.4
2021	10.6
2022	10.7
2023	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	$481	$652	$51	$69
2 year Deferral	$968	$1,276	$102	$134
3 year Deferral	$1,416	$1,831	$146	$189

*Total $/kVA over deferral period

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 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.b 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.c Install power factor correction

This option is not technically feasible as there are not enough large customers supplied out of Uraidla to make individual power factor correction viable and substation based correction would not address the identified need.

4.3.d 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 Stirling East and Aldgate substations.

4.3.e 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.f 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.g 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.h 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.i 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 Uraidla 66/33kV substation has therefore failed the Reasonableness Test and a Request for Proposal (RFP) will not be issued.