Network Consultation

Maintain reliability of electricity supply to Kalkallo Zone Substation customer's.

SP AusNet
A member of Singapore Power Group

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1 INTRODUCTION

1.1 Purpose

This consultation paper has been prepared to meet the requirements of chapter 5.6.2 (f) of the National Electricity Rules Version 53. It forms the basis upon which SP AusNet will consult with registered participants and interested parties on possible network support options, including but not limited to demand management and embedded generation to address the projected reliability constraint in the 66kV network supplying the Kalkallo zone substation 30km north of Melbourne.

1.2 Proposal

In the absence of alternative network support proposals SP AusNet proposes to construct a new 66kV line between Kalkallo and Doreen zone substations to reinforce the existing radial 66kV line from South Morang terminal station to Kalkallo zone substation. This project is provisionally scheduled for construction in 2015 with commissioning expected by November 2015. This project was first foreshadowed in the 2010 edition of SP AusNet's annual Distribution System Planning Report which covered the period from 2011 to 2015.

1.3 Constraint

The northern fringe of metropolitan Melbourne is one of the major growth corridors of Melbourne. The Cities of Hume and Whittlesea are centred on this growth area with a 2013 population of 358,481. This is expected to grow steadily to 395,135 people in 2016 and then 456,172 people by 2021.

Electricity demand is also expected to grow by up to 3% per annum in this region. The Kalkallo zone substation was commissioned in late 2010 to meet load growth in this region. This station currently supplies 6,700 SP AusNet distribution customers and will soon also supply Jemena Electricity Networks (JEN) customers with the establishment of a new JEN 22kV feeder in 2013.

Kalkallo zone substation was initially established with a radial 66kV supply emanating from South Morang terminal station (SMTS). Two sustained outages and nine momentary outages have occurred on this 66kV line in the last 15 months since it assumed its current configuration. All sustained outages and momentary outages negatively impact upon the electricity services to 6,700 customers supplied from Kalkallo zone substation.

In summary the network constraint is: ***Loss of electricity supply to 6,700 customers supplied from KLO zone substation following a fault on the radial SMTS-KLO/KMS 66kV line.***

1.4 Consultation

This paper is published, as required by the National Electricity Rules for a new large distribution network asset above $10m in value, to establish whether network support services are an economic alternative to the network augmentation proposal. This paper details the service levels sought from network support services.

SP AusNet is seeking offers from providers of network support services including generation and electricity demand management which may singly or in combination prove to be more economic than the network augmentation proposal.

The consultation period is 3 months commencing at the publication date of 6 August 2013.

Offers for network support must be received by SP AusNet by 6 November 2013

Offers of network support should be marked for the attention of

Stephen Lees
Lead Engineer, Subtransmission Network Planning
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SP AusNet will assess options identified through this process and then apply the Regulatory Test to determine the most cost effective option.

Any enquiries regarding this network consultation paper may be directed to:-

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Email: stephen.lees@sp-ausnet.com.au

2 BACKGROUND

The Cities of Whittlesea and Hume as well as the Shire of Mitchell to the north are centred on the northern growth corridor of urban Melbourne within the urban growth boundary. The following figure 1 shows the urban growth boundary, the new land releases for development and the location of the existing Kalkallo Zone Substation. This growing region will require new infrastructure to meet the community's energy needs including electricity and gas. It is clear from figure 1 that the Kalkallo Zone Substation is well placed to meet future electricity load growth in this area.

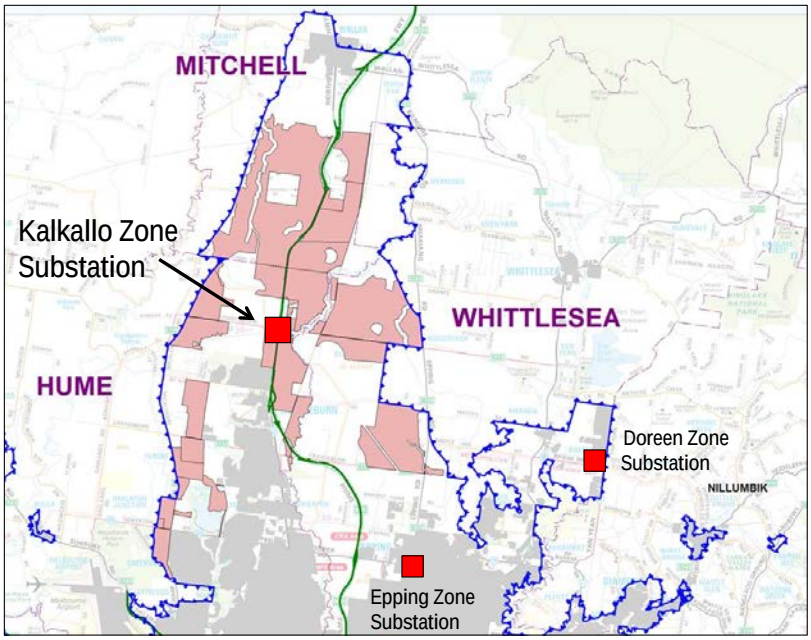


Figure 1 - Melbourne urban growth boundary and location of Kalkallo Zone Substation.

Population statistics available from the web sites for all three local government areas shows population growth from 370,551 people in 2011 to 437,626 people in 2016 and then to 509,591 people in 2021. These increases are at a growth rate of 3.3% per annum. Figure 2 shows the population increases for all three council areas through to 2031.

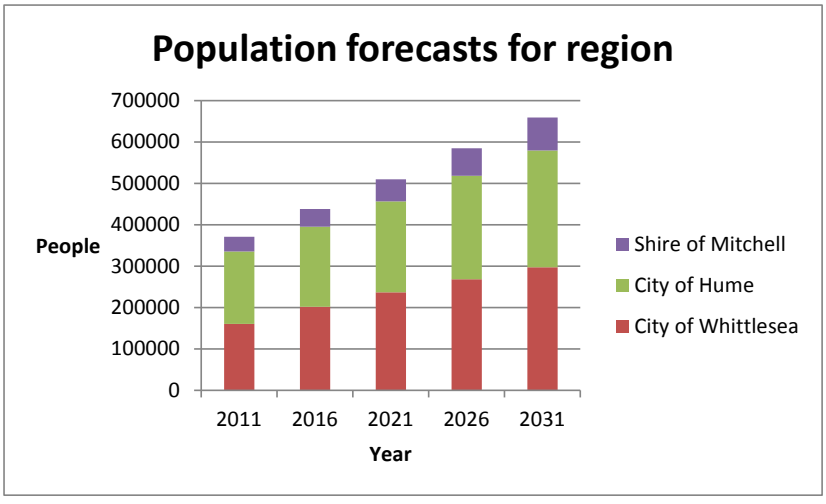


Figure 2 - Population growth for Cities of Hume, Whittlesea and Shire of Mitchell.

Dwelling numbers are also growing at a rate slightly higher than population due to a slight decline in the average number of people per dwelling over the forecast period. The electricity demand also is expected to grow in line with population increases.

Increasing electricity demand will come from significant volumes of new residential load as many areas are zoned residential as well as smaller commercial and industrial areas. There will also be significant demand increases associated with the "Merrifield" development. This development covers a 900 hectare site immediately to the north west of KLO and includes 4000 homes in a residential area, a commercial area including shopping, entertainment and dining and a business park for industrial uses.

3 NEED

3.1 Supplies to KLO customers

The Kalkallo zone substation (KLO) is supplied by a radial 66kV line from South Morang terminal station (SMTS). This 66kV line to KLO also supplies Kilmore South Zone Substation (KMS).

The following figures 3 & 4 show the arrangement of the 66kV network which supplies KLO and KMS. This line from SMTS to KLO is 25.5 kilometres in length but also contains another 33.9 kilometres of line to KMS from the tee point.

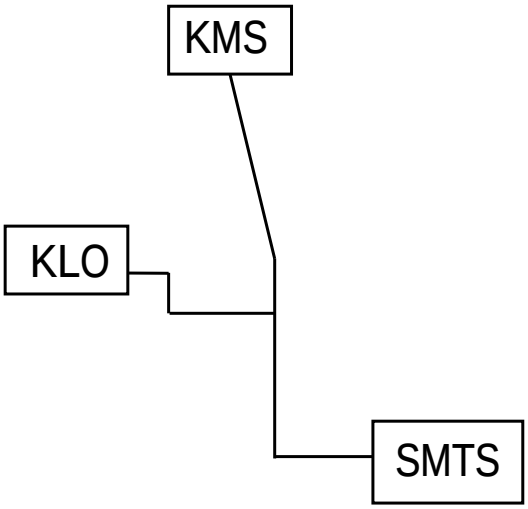


Figure 3 – 66kV Single Line Diagram

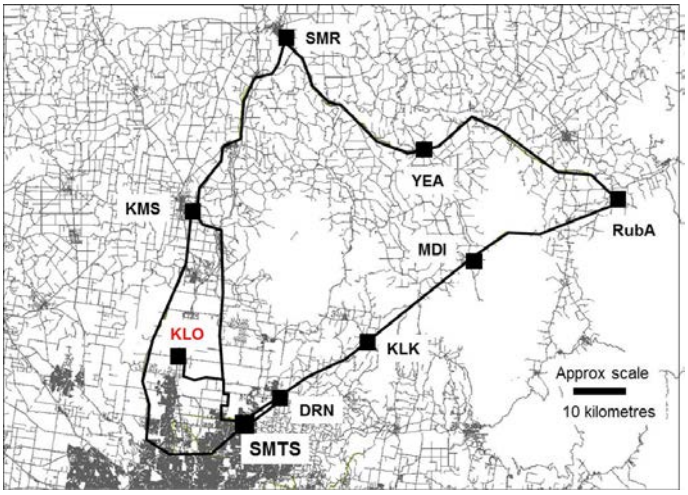


Figure 4 – Map of Subtransmission Circuits

3.2 KLO customer loads

The Kalkallo Zone Substation recorded a peak demand of 14.9 MW on 12 March 2013.

The following Figure 5 provides 50% Probability of Exceedence (POE) MW peak demand forecasts for the loading at KLO zone substation for the period 2016 to 2022.

Peak demand	2016	2017	2018	2019	2020	2021	2022
SP Ausnet load	18.65	19.67	20.58	21.37	22.06	22.62	23.08
Jemena load	7.13	8.74	9.30	7.61	9.84	11.87	13.06
TOTAL PEAK LOAD	25.78	28.41	29.88	28.98	31.90	34.49	36.14

Figure 5 - Peak demand at KLO

The following Figure 6 provides the average load at a load factor of 0.6 and therefore the amount of load that would be lost on average for failure of the single radial 66kV supply to KLO:

Average demand	2016	2017	2018	2019	2020	2021	2022
SP Ausnet load	11.19	11.80	12.35	12.82	13.24	13.57	13.85
Jemena load	4.28	5.24	5.58	4.57	5.90	7.12	7.83
AVERAGE TOTAL LOAD	15.47	17.05	17.93	17.39	19.14	20.69	21.68

Figure 6 - Average demand at KLO.

3.3 KLO Security and reliability

In the event of a fault anywhere on the 66kV line between SMTS, KLO and KMS resulting in loss of supply at KLO SP AusNet can supply some KLO load via two interconnecting 22kV feeders from Epping Zone Substation (EPG) and JEN will be able to supply some load via one interconnecting feeder from Somerton Zone Substation (ST) by late 2013 when their new feeder is commissioned. Currently a total of 12 MW can be supplied from the interconnected feeders in the event of loss of supply at KLO. However this capability is decreasing by 1 MW per annum due to load growth on the interconnected network.

The interconnected 22kV distribution network can be reconfigured within 30 minutes using remote control switches to restore supplies to some customers following a fault on the 66 kV line supplying KLO. However, in future years an outage of this 66 kV line means an increasing proportion of the "average total load" as detailed in Figure 6 above cannot be supplied from the existing networks.

The SMTS-KLO/KMS 66kV line has experienced two sustained and nine momentary outages in the last 15 months resulting in significant disruption to the 6,700 existing electricity customers supplied from KLO. This radial 66kV line can be expected to be unavailable for an average of 2 hours per annum (0.0001%) based on long term average performance of 66kV lines in urban Victoria.

3.4 Value of unserved energy

In 2016 when it is expected that 9 MVA of load is able to be recovered within 30 minutes by switching back to interconnected feeders the expected unserved energy is 17.44 MWhrs. This unserved energy comprises the average load of 15.47 MW unserved for 0.5 hours plus the average load remaining after transfers of 6.47 MW for 1.5 hours. This is valued at $1,141,000 at a Value of Customer Reliability of $65,436 per MWhr[1] for load supplied from South Morang Terminal Station. Prima facie it is economic to invest up to $15.44M at a cost of capital of 7.39% to remove this constraint prior to 2016.

The following figure 7 shows the increasing customer impact from failures of the radial 66kV line from 2016 as load growth continues as forecast.

[1] 2012 Transmission Connection Planning Report

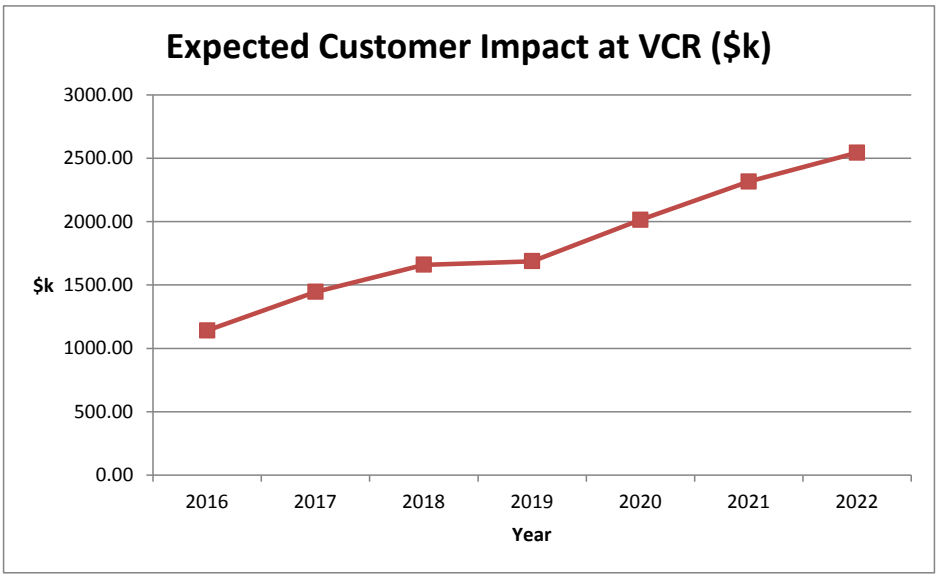


Figure 7 - Growth in economic losses for KLO customers from 66kV line outages

4 OBLIGATIONS

SP AusNet has obligations under the National Electricity Rules and Victorian Electricity Distribution Code to provide an adequate electricity network to supply forecast customer demand. The National Electricity Rules clause 6.5.7 includes requirements for SP AusNet to ***meet or manage the expected demand*** and to ***maintain the quality, reliability and security of supply*** to our customer's. The Victorian Electricity Distribution Code clause 3.1 includes requirements for SP AusNet to develop its distribution network to ***minimise the risks associated with failure or reduced performance of its assets.***

Further detailed information on SP AusNet's planning standards is available in the Distribution System Planning Report available on the SP AusNet web site.

5 OPTIONS BEING CONSIDERED

Several alternatives including both network augmentation and network support options will be considered by SP AusNet to address the supply risks at Kalkallo:

5.1 Option 1 - Do nothing

Doing nothing is not consistent with the obligations of the National Electricity Rules to

- meet or manage the expected demand; and
- maintain the quality, reliability and security of supply.

Doing nothing is not consistent with the obligations of the Electricity Distribution Code to

- to minimise the risks associated with the failure or reduced performance of assets;

Doing nothing is not economic as:-

The existing radial 66kV network cannot provide an adequate 66kV supply for the customers of this area. The radial SMTS-KLO/KMS 66kV line configuration will result in loss of supply to increasing

numbers of customers each time this 66kV line has an outage. It is standard electricity industry practice to secure incoming 66kV supplies to zone substations in urban areas with the provision of a minimum of two separate supplies allowing supply to be maintained during a single network contingency. Probabilistic studies considering the probability of a line outage indicate that KLO customers could expect to face annual losses amounting to $1,141,000 due to unplanned outages by 2016. This will grow as shown in Figure 7.

5.2 Option 2 - New KLO-DRN 66kV line

In the absence of an economic network support proposal; this option is expected to be the preferred network augmentation option to secure 66 kV supplies to Kalkallo zone substation and involves the construction of a new 66kV line between Kalkallo and Doreen zone substations.

A line route along Bridge Inn Rd, Schotters Rd, Plenty Rd and Donnybrook Rd over a total distance of 24 kilometres has been identified. The following figure 8 shows the route of the new 66kV line:

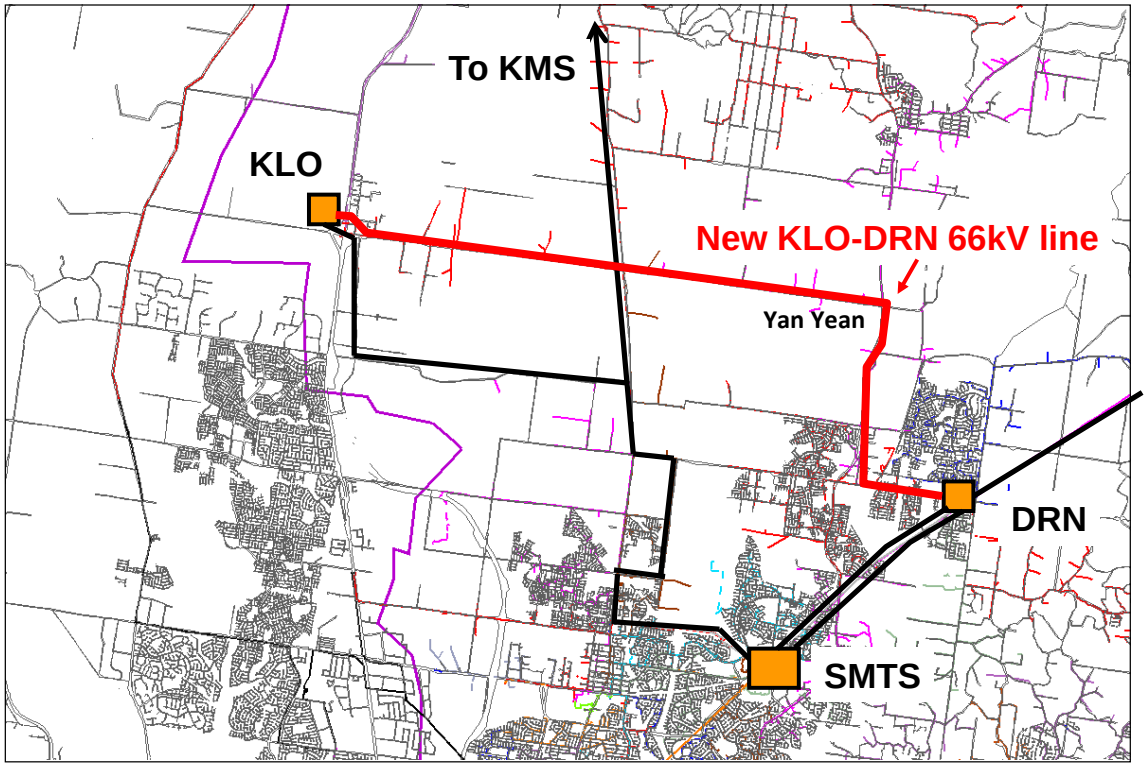
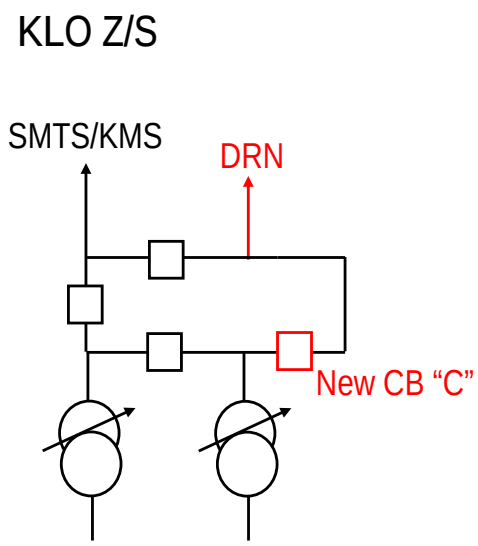


Figure 8 – Line route for KLO-DRN 66kV line

66kV Ring buses have been constructed at both Kalkallo and Doreen Zone Substations to accommodate the proposed additional 66kV line connection as shown in the following Figures 9 and 10



Figures 9 – 66kV bus work at KLO

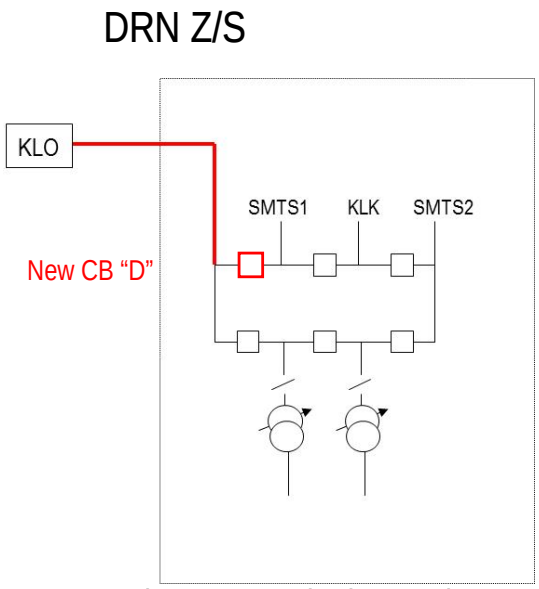


Figure 10 – 66kV bus work at DRN

A future benefit of this option is that it is consistent with long term development plans for this area by providing a 66kV circuit through Yan Yean where a zone substation may be required in the longer term.

5.3 Option 3 - New SMTS-KLO 66kV line

In the absence of an economic network support option a second alternative 66kV line route has been identified to secure electricity supplies to KLO customers A line route along McDonalds Rd, Epping Rd, O'Hern's Rd and Hume Hwy has been identified over a route length of 26 kilometres. The following figure 11 shows the route for this option:

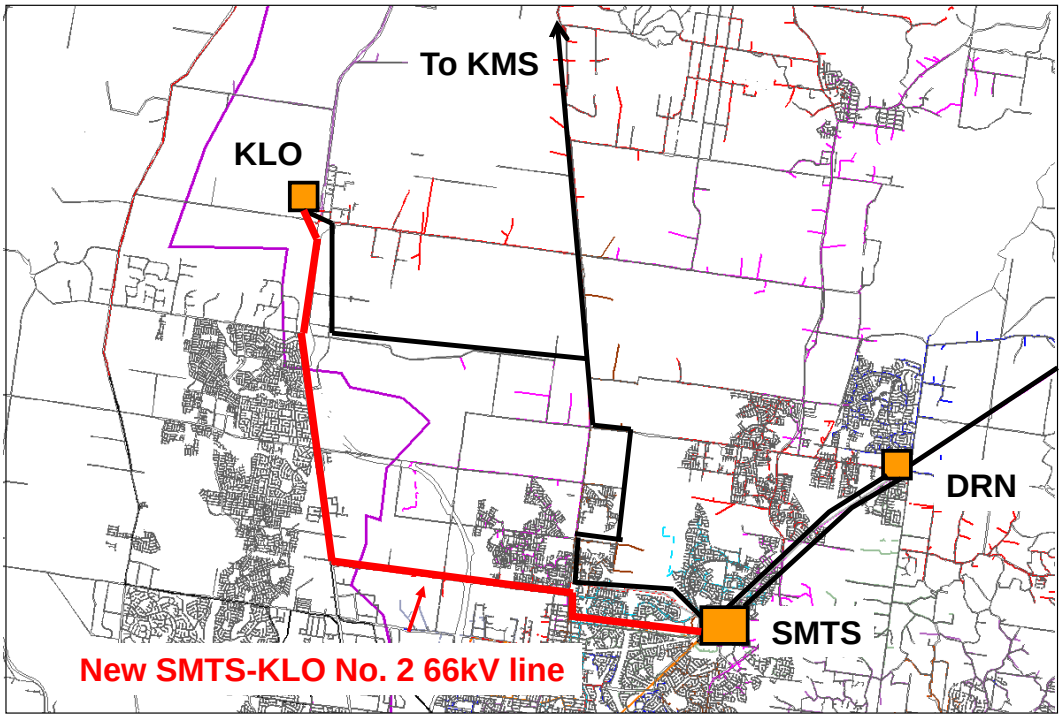


Figure 11 – Alternative route to secure second 66kV supply to KLO

This alternative route has several disadvantages:

- A route along McDonalds Rd could be achieved with the duplication of the existing SMTS-EPG No. 1 66kV line via double circuit construction but at a high construction cost,
- The section north along Epping Rd would then be required though an established commercial area, also at a high cost of construction,
- The section in O'Hern's Rd would require a duplication of the existing SMTS-ST 66kV line which would also require the rebuild of an existing 66kV line to double circuit construction. An alternative route along Cooper St could avoid Epping Rd and O'Hern's Rd but this area is already served by underground electricity circuits supply and it would be difficult to acquire permits to establish the 66kV line as overhead construction.

Construction of the final section along the Hume Hwy is considered straight forward.

At around 26 kilometres the overall route length is slightly longer than that for Option 2, and the construction is more complex. The overall cost is expected to be higher for this option when compared with the preferred option, Option 2.

5.4 Option 4 - Connect KLO to existing SMTS-KMS 66kV line.

In the absence of an economic network support option; a third network augmentation option is to bring a second 66kV line into KLO from the existing SMTS-KMS 66kV line. This would involve constructing a new 66kV line west from KLO for five kilometres along Donnybrook Rd and connecting it into the existing SMTS-KMS 66kV line in Old Sydney Rd at Mickleham as shown in the Figure 12 below:-

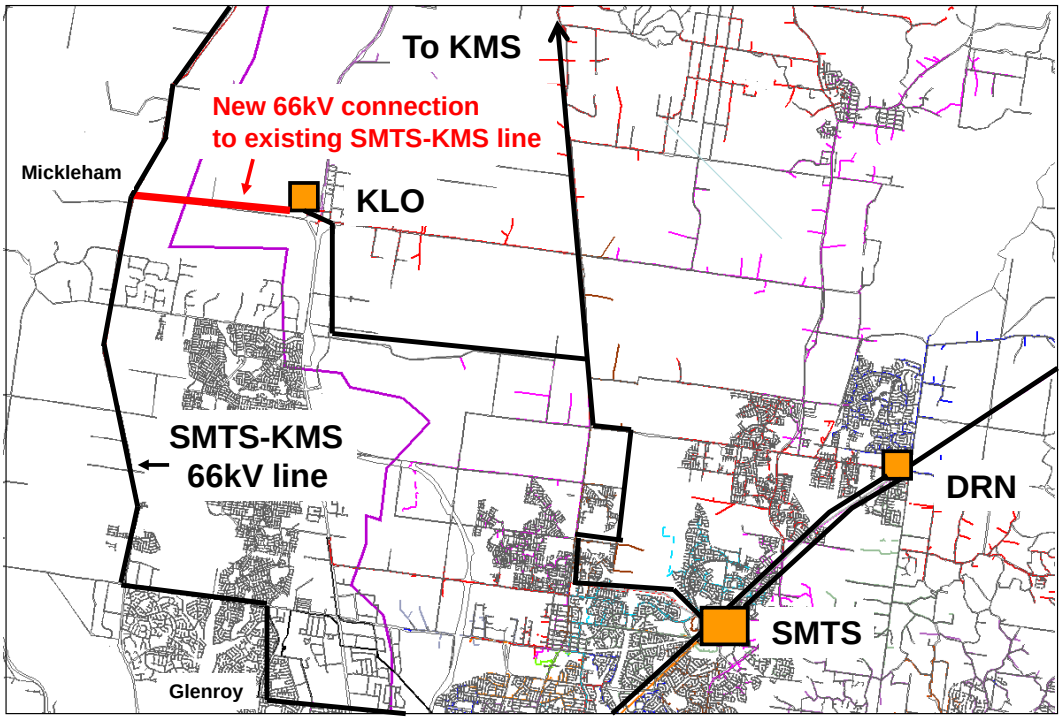


Figure 12 – Connect into existing SMTS-KMS 66kV line to secure second 66kV supply to KLO.

This option will require 25 kilometres of the existing SMTS-KMS 66kV line between Glenroy and Mickleham to be re-conductored to 37/3.75 AAC to provide sufficient capacity to support the KLO load under an outage of the existing SMTS-KLO/KMS 66kV line. The re-conductoring would require

a complete line rebuild involving additional and taller poles as the existing SMTS-KMS 66kV conductor is the much smaller 6/1/.186 ACSR.

The overall route length of new and re-constructed 66kV lines is around 30 kilometres so the overall cost is expected to be higher for this option when compared with the preferred option; option 2.

5.5 Option 5 - Install a 66kV switching station at Wollert

The performance of the existing SMTS-KLO/KMS 66kV line is impacted by the 33.9 kilometres of line between the 66kV tee at Wollert and Kilmore South zone substation (KMS). Faults in this section of line cause an outage on the entire three ended SMTS-KLO/KMS 66kV line and consequent loss of all supply to KLO customers although no fault has occurred in the direct line route between SMTS and KLO.

In the absence of an economic network support option, a 66kV switching station that allows faults between the tee at Wollert and KMS to be cleared without interruption to the supply to KLO would improve the security of electricity supplies to KLO customers. SP AusNet owns a site for future zone substation at Wollert (WLT) and this does provide the option (Option 5) for the construction of a switching station at Wollert to achieve this outcome. The following Figures 13 and 14 show firstly the single line diagram of work at the Wollert site and then secondly a single line diagram of the 66kV lines to achieve this option. The work at WLT is consistent with the eventual development of WLT (expected in the next 10 years) as a zone substation as shown in the following Figure 13.

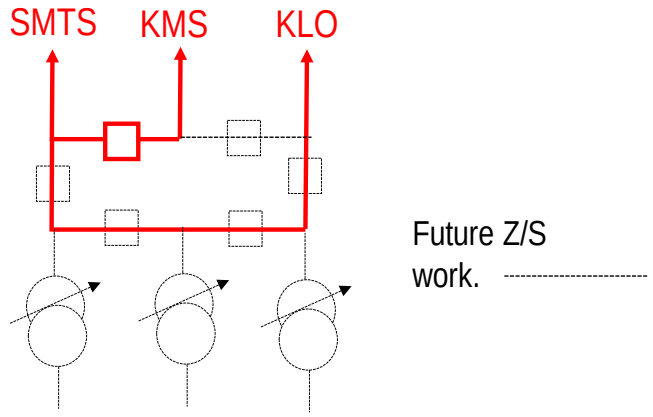


Figure 13 – WLT site works

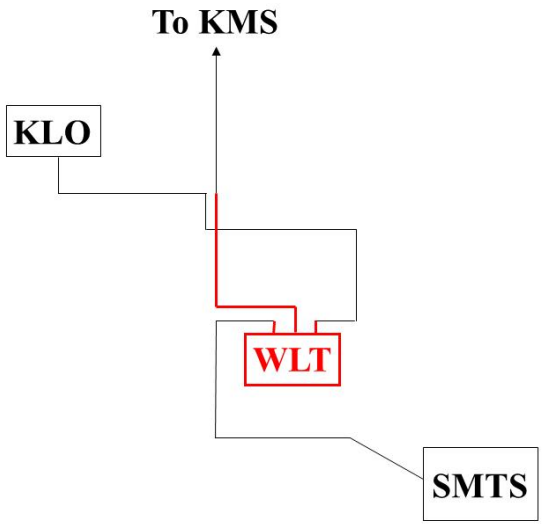


Figure 14 – Single line diagram

However, any faults in the line section directly between SMTS and KLO will still cause customer outages at KLO and loading at KLO is growing steadily. Construction of the Wollert switching station may be an economic option to defer the KLO-DRN 66kV line construction for a few years.

However, this option has a loading limitation as load flow studies show that only 6 MW of load can be supported at KLO via the KMS-KLO line during an outage of SMTS-WLT line. The switching at WLT cannot allow the KLO load to be supported via KMS limiting the benefit achievable by this work.
This load limitation may impinge on the deferral period offered by this option. Depending on the cost of this option and the deferral offered it may be the most economic option and this will be further tested once all options are understood.

5.6 Option 6 - Install a new power station

The operation of a power station or stations connected into the 66kV or 22kV network at a suitable node or nodes could provide an economic electricity supply for KLO customers in the event of a failure of the existing radial SMTS – KLO/KMS 66kV line. In the case of an outage of this line in the year 2020; up to 40 MVA of customer load would require support.

To provide equivalent supply reliability to the likely preferred network augmentation option a power station would need to operate continuously and be capable of operating in an islanded mode to address the possible sudden loss of the radial 66kV line. SP AusNet considers that whilst there would be considerable cost and technical challenges in achieving this outcome this option is technically viable.

Generation could also be operated in standby mode with a rapid start immediately after a 66kV line fault has occurred which allows restoration of supply to some or all of the lost customer load following a short outage. This generation could connect into the 66kV network and operate as an island or it could connect into the 22kV network at a number of points to directly support the 22kV feeder loads in conjunction with ties to adjacent zone substations. This alternative has lower value compared with other options as all KLO customers still endure momentary outages and short duration outages whilst the generation accelerates to full capacity following a line fault.

Connection of a generator may require modification of the network at or near the connection node to facilitate safe and reliable operation of the generator and the network. In particular, connection of additional embedded generators will increase network fault levels and fault level mitigation measures may be required. It is equitable for the proponents of such projects to bear the costs of fault level mitigation works.

The technical and economic challenges in using generation to address this type of constraint are noted but the merit of these generation options will be economically weighed in the application of the regulatory test.

5.7 Option 7 - Demand management

Traditionally a demand management response is not often considered viable for this type of network capacity constraint. Demand management is more commonly used where a network becomes constrained for a short period of high demand.

The SMTS-KLO/KMS 66kV line is constructed using 3-37/3.75 AAC conductor that has a thermal rating of 1025 amps (117.2 MVA) in summer and the customer load at KLO is not forecast to exceed this figure in the next 10 years. The total 66kV line length is 25.5 kilometres so voltage levels remain satisfactory during periods of high demand. In summary, the existing line is not subject to any constraint under system normal conditions. The constraint is solely loss of supply under outage conditions of the SMTS-KLO/KMS 66kV line.

A demand management option would need to contract with all KLO customers including large numbers of residential customers for sudden loss of supply. If sufficient customers can be contracted for a demand reduction response which economically reduces the customer impact then a demand side response may be able to be considered.

Confirmation of the technical and economic merit of a demand management response will be economically weighed in the application of the regulatory test.

6 VALUE OF NETWORK SUPPORT

This section provides information on the value of network support options and the service levels sought.

6.1 Value of deferring network augmentation

SP AusNet must be able to demonstrate that the option recommended to address this constraint can be implemented by the required service date and is more economic than other network support and network augmentation options.

The network augmentation options outlined in section 5 provide some benchmarks on the timing, service levels and costs to address this constraint against which network support services can be compared.

Option 2 - A new 66kV line between Kalkallo and Doreen Zone Substation is expected to cost around $13m to $16m to construct. Option 5 - A switching station at Wollert is expected to cost around $8m to $10m to construct. At the current SP AusNet Weighted Average Cost of Capital (WACC) rate of 7.39% p.a. these two options have capital expenditure deferral values in the range $600,000 to $1,200,000 per annum.

Accordingly, SP AusNet expects that network support services which can be delivered by November 2015 and which offer equivalent levels of service to network augmentation can be contracted for less than $600,000 to $1,200,000 per annum.

6.2 Level of network support

For a network support option to provide an equivalent service level to the network augmentation options it must be capable of matching the increasing load at KLO zone substation. The demand forecasts provided in section 2 show the required level of network support that is required to fully replace the proposed network augmentation and this reaches 40.75 MVA in the year 2020.

An equivalent level of network support service is that which when the existing 66kV radial line fails the network support can supply the demand immediately and continuously in an islanded operating mode. Alternatively a network support service that can start operation immediately after a line outage and supply either all or part of the lost load will be considered at commensurately lower values of remuneration.

The required level of network support is based on current demand forecasts but there is significant uncertainty in the load growth for the Kalkallo area. Proponents of network support options are encouraged to indicate what capability exists to meet additional loads to cater for the circumstance that actual demand exceeds the current forecasts.

SP-AusNet will consider smaller sized generation proposals that cannot fully cover the risk levels detailed above but are able to reduce the risk to some degree. The applicable network support payments would be proportional to the benefit provided.

6.3 Security of network support services

The radial 66kV line is subject to failure due to natural events such as storms at any time so equivalent network support services would need to be available at all times if contracted to provide a service level equivalent to the network augmentation options.

For options that propose a partial network support service where service commences after an outage has occurred an average rate of 2 hours per annum and 2 outages per annum is typical of the reliability of urban 66kV lines.

6.4 Information to be provided in proposals

Proponents of network support proposals are encouraged to contact SP AusNet as soon as possible to determine the technical and commercial viability of their proposal. Initial discussions are expected to inform the development of a detailed submission to SP AusNet by the due date including the following details:

1. proponent name and contact details;
2. a detailed description of the proposal;
3. electrical layout schematics;
4. a firm nominated site;
5. capacity in MW to be provided and number of units to be installed (generation);
6. fault level contribution, load flows, and stability studies (generation);
7. a commissioning date with contingency specified;
8. availability and reliability performance benchmarks;
9. network interface requirements as agreed with SP AusNet;
10. the economic life of the proposal;
11. banker/financier commitment;
12. proposed operational and contractual arrangements;
13. any special conditions; and
14. evidence of a planning application having been lodged, where appropriate.

7 PREFERED SOLUTION, FINAL REPORT AND TIMING

The preferred solution and timing will be determined by the application of the Regulatory Test for both for network augmentation and network support options or a combination of options as appropriate. The regulatory test will be applied in accordance with the Australian Energy Regulators Version 3 Application Guidelines to determine the option that maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the National Electricity Market.

The nominal timing for this project is completion by November 2015 however the load growth uncertainty means that this timing may vary. SP AusNet will critically review forecasts each year to determine the efficient timing to address this constraint.

SP AusNet expects to publish a final report as required by clause 5.6.2 (h) of the National Electricity Rules (Version 53) by 31st March 2014 to inform registered participants and interested parties. It will contain the following information:-

- An assessment of all identified options considered,
- Details of the preferred proposal including its economic effectiveness,
- A summary of submissions from this consultation, and
- The recommended action.