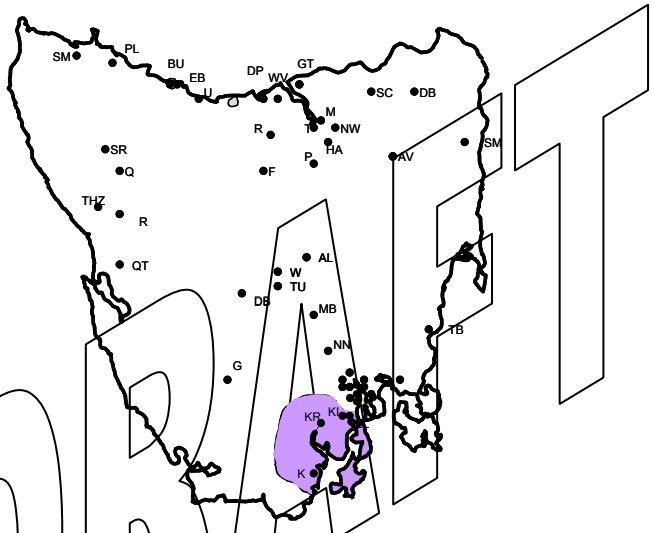
ABN 85 082 464 622






# SOUTH AREA

# DEVELOPMENT PLAN

| REV NO. | DATE | REVISION DESCRIPTION | APPROVALS | |
|---|---|---|---|---|
| 0 | | Working Draft | Prepared by | |
| | | | Reviewed by | |
| | | | Approved by | |
| | | | | |
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# 1. EXECUTIVE SUMMARY

The South planning area includes the Kingston area South of Hobart, Bruny Island and the Huon valley.

South is considered a high growth area, recording growth rates of greater than 4% pa for the past three years. In particular, the coastal areas including the towns of Kingston, Blackmans Bay, Margate and Electrona are expected to continue to experience significant commercial and residential development.

The remainder of the planning area consists predominantly of light farming and forestry load.

To facilitate the current and forecast load, the South planning area maintains a distribution network at 11kV, The Browns Road 33/11kV zone substation is planned for completion in 2012. The network in the South planning area supplies 23,343 connected customers supplied by 4 11 kV substations and 1,467 km of OH and UG circuit.[1]



The identified or known large constraints are as follows:

- 

To address the above constraints the following is being proposed:

- 

[1] Data available in NW-#30146137-Feeder Data for Development Plans.

# TABLE OF CONTENTS

# 2. EXISTING SYSTEM

## 2.1 Substations

The substations supplying the South planning area are listed below.

Note: hyperlinks in the section below will display the power circuit one line diagram from Transend's Operational Diagram System.

**Transend owned substations**

- Electrona (click here to see the 110/11kV single line diagram)
- Kermandie (110/11kV)
- Kingston (110/11kV)
- Knights Rd (110/11kV)

**Aurora owned substations**

- Browns Rd zone substation (approved 2012).



## 2.2 Supply Network

Distribution within this planning area is at 11kV, supplied by 110/11kV terminal stations.

The South planning area has been combined into a group of substations, with members of the group having significant transfer capacity amongst each other. The substations within the group are Kingston terminal substation and Browns Rd zone substation, with future zone substations in the Kingston area included as they are established. It is assumed that a capacity limitation occurs when the group load exceeds the sum of the firm capacities.

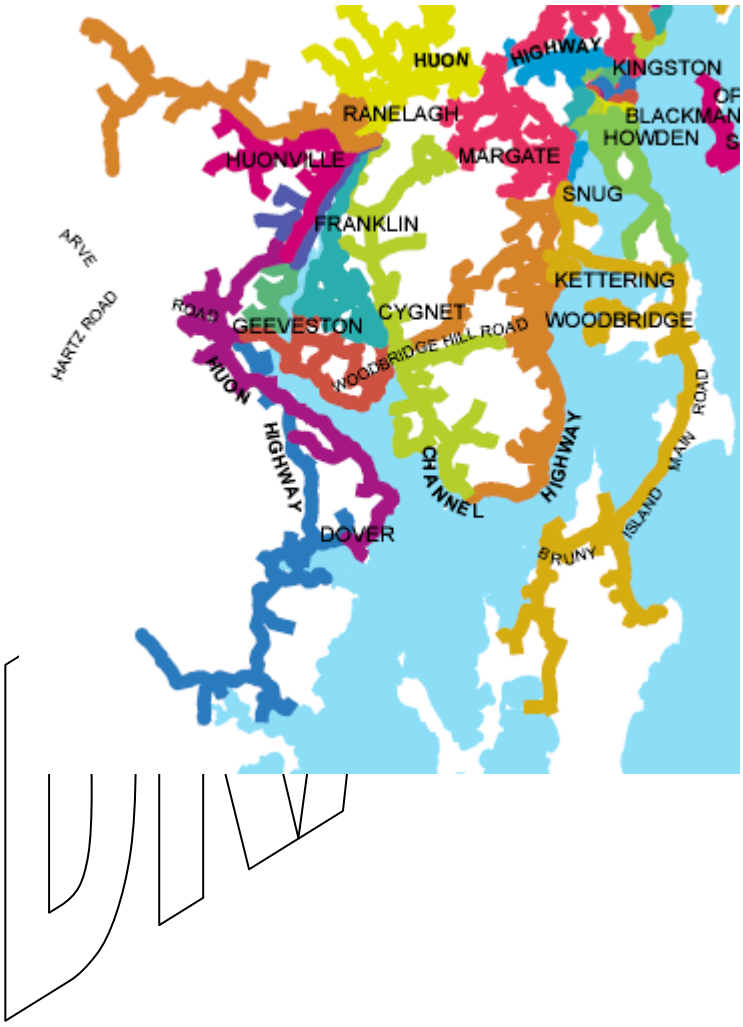
## 2.3 Network Statistics

South planning area network statistics [2]

| | | |
|---|---|---|
| 11kV circuit length | 1,467 | km |
| Connected customers | 23,343 | |
| Connected transformer capacity | 280,600 | kVA |
| Customer density | 16 | per 11kV circuit km |
| Transformer capacity density | 191 | kVA per 11kV circuit km |

[2] Data sourced from Gtech, query DISTFDR. See NW-#30146137-Feeder Data for Development Plans.

The maps below show the geographic extent of the South planning area.




DRAFT

# 3. LOCAL PLANNING ISSUES

## 3.1 Long Term System Strategy

Development of the South planning area will continue using the existing 11 kV distribution network, supplied from Transend's 110/11kV substations. The introduction of a 33 kV subtransmission voltage and Aurora owned 33/11kV zone substations is planned in the near future with the commissioning of Browns Road substation 2012. Further zone substations are planned for later years.

The distribution arrangement of both 11 kV Major Injection Points and Aurora owned 33/11 kV zone substations will co-exist for the foreseeable future.

Highly interconnected Low Voltage reticulation will continue to develop at 433V.

Embedded Generation options will be encouraged at the 11 kV and 433V connection points.

Demand Side Management solutions will be encouraged to reduce system peaks and defer large system upgrades where possible.



## 3.2 Local Government Authorities

The South planning area includes the.

For planning purposes, Aurora consults closely with the following local government authorities in the South planning area:

- Kingborough Council, and
- Huon Valley Council

Other relevant authorities include:

- Department of Infrastructure, Energy and Resources (DIER); and
- Southern Water Tasmania.

## 3.3 Existing Critical Loads

South planning area has a large number of existing critical loads requiring a higher level of supply security or a limit to operational flexibility. Table 1 below details critical loads in the South planning area:

| Load Type | Description | Substation(s) | Feeder(s) | Asset Connection Point(s) - if applicable |
|---|---|---|---|---|
| Commercial / Major Retail | | | | |
| | | | | |
| | | | | |
| | | | | |
| Medical | | | | |
| Rehabilitation Services | | | | |
| Industrial | | | | |
| | | | | |
| | | | | |
| | | | | |
| Sewerage Treatment Plants | | | | |
| | | | | |
| | | | | |
| Education | | | | |
| | | | | |

**Table 1 – South Planning Area - Critical Loads**



Improvements to supply security for the above connections and supply areas are encouraged.

## 3.4 Future Developments and Restrictions

- Council planning schemes

### Kingborough Council

The Kingborough Council has advised that land will continue to be released to the West of Kingston and Blackmans Bay, and around Margate, but will be mostly utilised by 2021. Further population increases are to be addressed by infill and higher density development. Medium and higher density development will focus on bus trunk routes.

### Huon Valley Council

The predominant industries in the Huon Valley area are aquaculture and fishing, forestry, agriculture and tourism. The Huon Vale Council has expressed desire to contain growth to existing settlements.

## 3.5 Reliability for the area

The South Area includes the following Reliability communities:

- Kingston Commercial (High Density Commercial)
- Huonville (Urban)
- Kingston – Blackmans Bay (Urban)
- Margate – Snug (Urban)
- Huon – Channel (High Density Rural)
- Huonville – Cygnet (High Density Rural)
- West Huon River (High Density Rural)
- Bruny Island (Low Density Rural)
- Channel Rural (Low Density Rural)
- Dover Rural (Low Density Rural)
- Huonville Rural (Low Density Rural)
-



Details of actual reliability performance in the 09/10 financial year are available in here. (DM ref# 30061377)

On figures for the 9 months to March 2010 the following communities appear likely to have reliability performance worse than target in 2010:

- Margate – Snug (Urban)
- Huon – Channel (High Density Rural)
- Huonville – Cygnet (High Density Rural)
- Bruny Island (Low Density Rural)
- Channel Rural (Low Density Rural)
-

The remaining reliability communities in the South Planning area have shown adequate reliability performance in 2009/10 up to March 2010.

## 3.6 Asset issues

There are no existing South Area zone substation transformers at or beyond their nominal end of life or in poor condition.

Further information is detailed in the following Asset Management Plans relevant to the HE planning area:

NW30084385 - Management Plan 2010: Ground Mounted Substations

NW30070052 - Management Plan 2010: High Voltage Regulators

NW30084411 - Management Plan 2010: Overhead System and Structures

NW30043361 - Management Plan 2010: Underground System

NW30084386 - Management Plan 2010: Zone Substations

## 3.7 Links

The LAM Area Management Plan relevant to the South planning area is:

- South NW-#142237-Area Management Plan South

In addition Transend's Annual Planning Report contains relevant information. It can be found on their website www.transend.com.au.

# 4. LOAD FORECAST

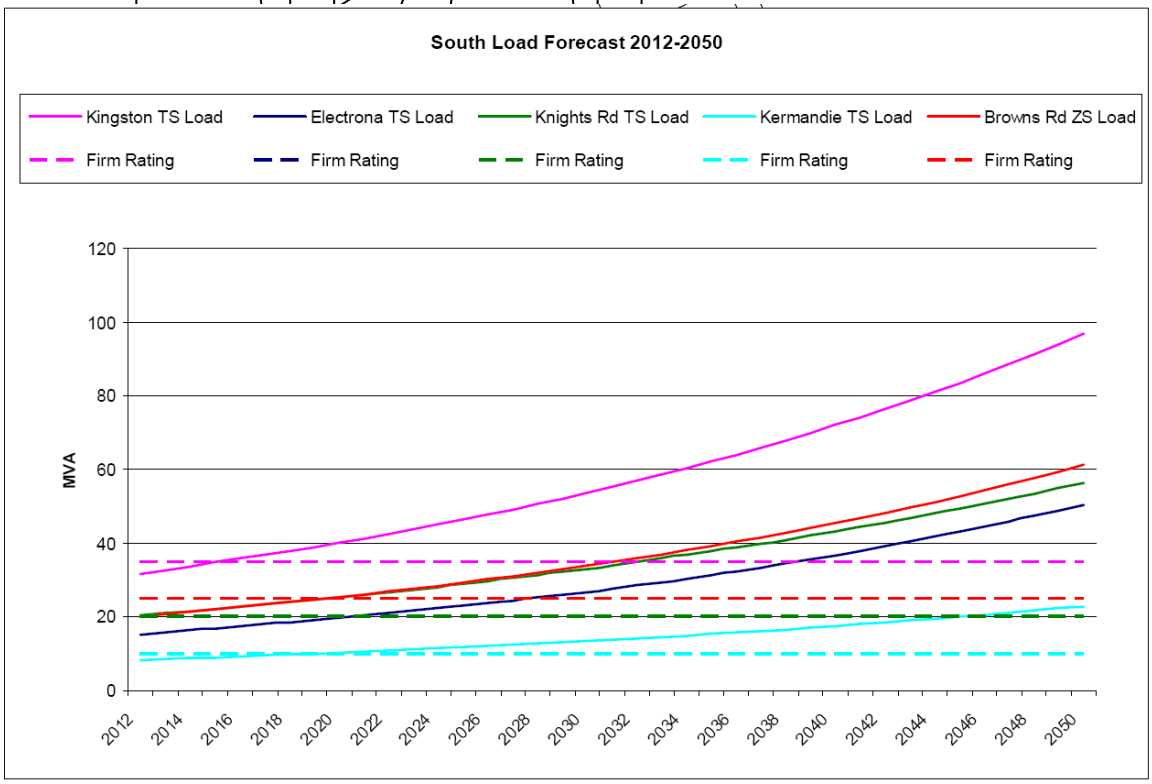
The South planning area has experienced growth above 4% per year for the past three years, and is considered one of the growth hotspots in the state. In particular, the coastal areas including the towns of Kingston, Blackmans Bay, Margate and Electrona are expected to continue to experience significant commercial and residential development.

The long term medium growth rate from the Aurora forecast is approximately 2.7% for the South planning area. Blanket load growth above this rate is considered unlikely, however higher growth is likely in certain areas.

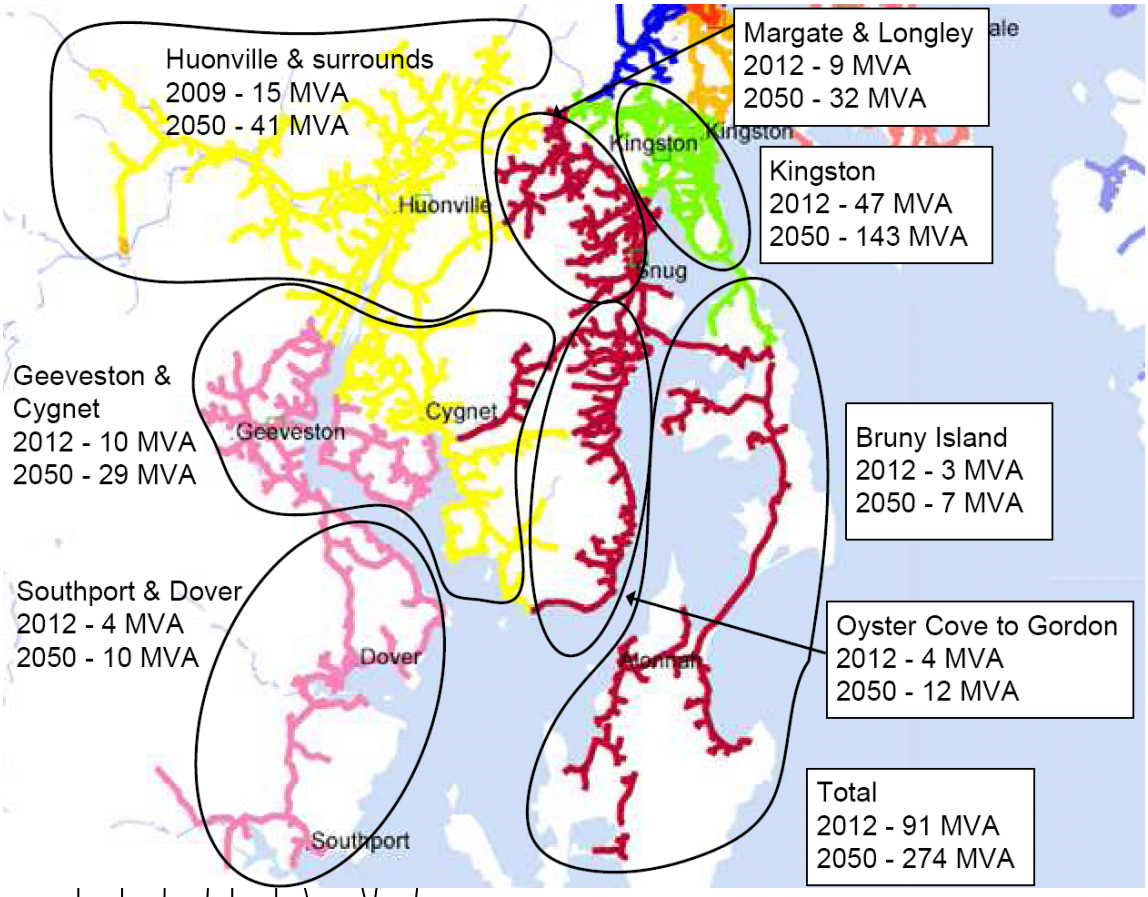
The Kingborough and Huon valley councils have indicated that the majority of future growth will be through infill of existing settlements rather than the release of new land. The exception to this is that land is to be released to the west of Kingston, Blackmans Bay and Margate.

As a result, to produce a conservative load forecast high growth has been applied to these areas, with medium growth applied to the remainder of the planning area.

The resulting 40 year load forecast and firm ratings for substations of the East Coast planning area are provided below.



The following figure provides a geographic view of the resulting load distribution in 2012 and 2050.




- The 2009 10 year load forecast report by UES is used as the basis for this plan. NW-#30083791-(pdf version) Aurora 2009 10year Load forecast - Draft
- Connected kVA (from Web map) customer connections)
- Description

Forecast load growth tables are stored in the spreadsheet NW-#30040697-Zone and Area MD and consumption tables 2009

| | Planning Area | Connection Point Substation | Forecast Growth pa |
|---|---|---|---|
| | South | Electrona | 2.80% |
| | South | Kermandie | 4.00% |
| | South | Kingston | 3.50% |
| | South | Knights Rd | 4.00% |

Copy of load profile

### 4.1 Future committed point loads (> 1 MVA)

- None identified

### 4.2 Possible point loads (> 1 MVA)

- Major Subdivisions (>200 lots)
  - o

### 4.3 Possible point loads to be removed (> 1 MVA)

- None identified

### 4.4 Possible future embedded generation (> 1 MVA)

- None identified

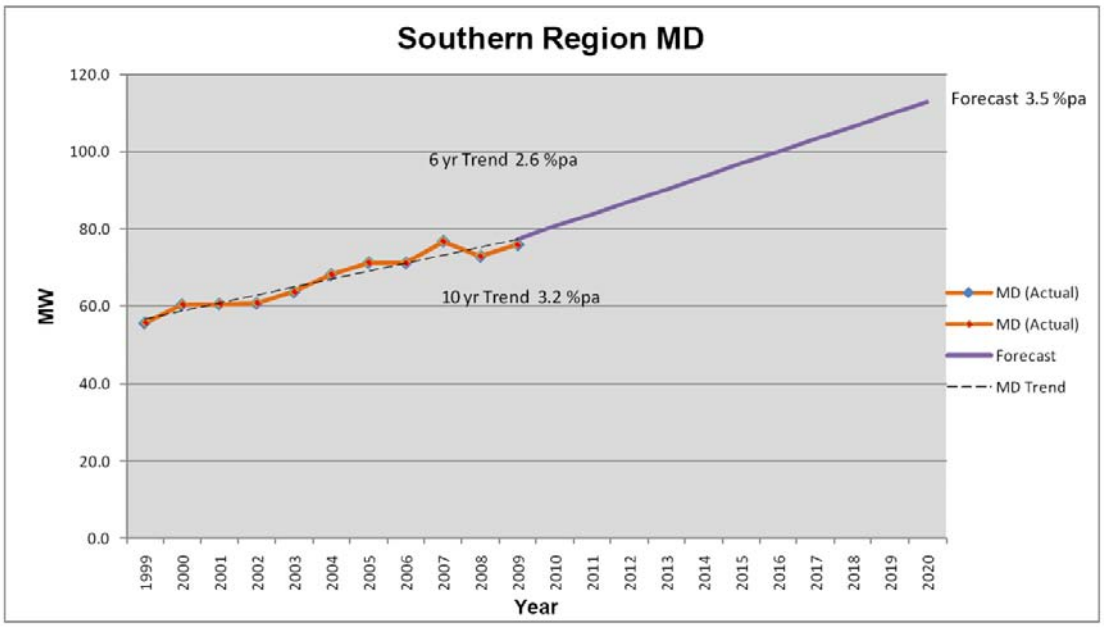
### 4.5 Analysis of Load Forecast

Detailed load forecast data is available in the following documents:

- Load model reference NW-#30060236-South area load model (2009), and NW-#30060429-Kingston Load Model 2008

The UES 10 year load forecast document can be found at

NW30089965 - Aurora 2009 Maximum Demand & Consumption 10 year Forecast Report



# 5. PLANNING CRITERIA

Aurora's Distribution Network Planning Manual issued in May 1999 is available in DM, ref NW10250570.

More up to date information is included in this document in Appendix E on page 20.

# 6. CONSTRAINTS (LIMITATIONS)

Constraints in the South planning area are classified under the following management groups:

| Constraint | Description | Definition |
|---|---|---|
| Capacity | Substation Firm Capacity | Substation Maximum Demand > Substation Firm Capacity (N-1) |
| | Feeder Tail Capacity | Feeder Maximum Demand > 5 MVA for 11 kV OR 10 MVA for 22 kV |
| | Feeder Section Capacity | Load through conductor >conductor continuous rating |
| | Feeder Tie Capacity | Transfer Capacity limited due to undersized conductor/equipment |
| Fault Level | Substation Bus Fault Level | Maximum 3-phase fault level > 13.1 kA OR Maximum 1-phase > XX.X kA |
| | Equipment Rating Fault Level | Maximum 3-phase OR 1-phase fault level > equipment rating |
| Voltage | Normal load Voltage Drop | Voltage drop exceeds ± 6% |
| | Emergency load Voltage Drop | Voltage drop exceeds ± 10% |
| Reliability | SAIDI | Reliability community SAIDI performance has or is likely to exceed target |
| | SAIFI | Reliability community SAIFI performance has or is likely to exceed target |

**Table 2 - Constraint Definitions**

Constraints are managed at the following levels

- Zone Substation
- Subtransmission Feeder
- Distribution Feeder
- Distribution Substation
- LV Systems

This document details constraints at the Zone Substation, Subtransmission Feeder and Distribution Feeder levels only. Refer to XXXXXXXXX for State wide management plans for the Distribution Substation and LV System planning levels.

## 6.1 Summary of Constraints

### *6.1.1 Terminal Substation Constraints*

| **Capacity Constraints** | | | | |
|---|---|---|---|---|
| **Substation** | **Firm Capacity (MVA)** | **Current Load (MVA)** | **Forecast to exceed (year)** | **Comments** |
| Electrona | | | 2028 | |
| Kingston | | | 2016 | |
| Knights Rd | | | 2012 | |
| Kermandie | | | 2019 | Aged Transformers recommended for replacement in 2015. |

| **Fault Level Constraints** | | | | |
|---|---|---|---|---|
| **Substation** | **Fault Level Description** | **Forecast (year)** | **replacement** | **Comments** |
| | | | | None identified |

### *6.1.2 Zone Substation Constraints*

The South planning area does not currently include any zone substation assets. Browns Road is planned to be commissioned in 2012.

| **Capacity Constraints** | | | | |
|---|---|---|---|---|
| **Substation** | **Firm Capacity (MVA)** | **Current Load (MVA)** | **Forecast to exceed (year)** | **Comments** |
| Browns Rd | | | 2020 | |

### *6.1.3 Subtransmission Constraints*

The South planning area does not currently include any subtransmission assets.

### *6.1.4 Distribution Feeder Constraints*

| **Capacity Constraints** | | | | |
|---|---|---|---|---|
| **Substation** | **Feeder** | **Capacity constraint type** | **Forecast to exceed (year)** | **Comments** |
| | | Feeder Tail | | |
| | | Feeder Section | | |
| | | Feeder Tie | | |

| Voltage Constraints | | | |
|---|---|---|---|
| **Substation** | **Feeder** | **Forecast to exceed (year)** | **Comments** |
| | | | None identified |

| Reliability Constraints | | | |
|---|---|---|---|
| **Substation** | **Feeder** | **Forecast to exceed (year)** | **Comments** |
| | | | None identified |

## 6.2 Security

- 

## 6.3 Transfer and Operational Capability

The table below shows the rating, peak load and transfer capacity. The peak load figures are those forecast for winter 2010. Since Aurora's substations are subject to winter peaks, these are the most onerous.

| | MVA | | | | |
|---|---|---|---|---|---|
| **Substation** | **Rating** | **N-1 Rating** | **Peak Load** | **Transfer Capacity (2010)** | **Transfer Substation** |
| Kingston | | | | 3.0 | Electrona |
| Electrona | | | | 2.5 | Kingston |
| Knights Road | | | | 0 | |
| Kermandie | | | | 0 | |

The table shows that…

Details of the analysis carried out on load transfers in the HE area are available in NW-#30066972-South area load transfer (2009).

## 6.4 Power Factor

## 6.5 LV issues

There are no locations in the South Planning area where widespread LV network issues have been identified.

The table below shows the count of transformers in the planning area and the count of those that are at risk of overloading. This is determined by the count of connected customers indicated a load greater than 130% of nameplate rating. It should be noted that the actual load on a transformer may be much different to its value calculated in this way.

| | Total | | >130% of rating[3] | |
|---|---|---|---|---|
| **Tx size** | **Count** | **Customer Count** | **Count** | **Customer Count** |
| **< 50 kVA** | 1,870 | 3,596 | 17 | 133 |
| **>= 50 kVA** | 1,661 | 18,945 | 32 | 1,252 |

## 7. SHORT TERM PLAN (<5YR)

The Sorell Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30103849-South strategic plan Rev_3.

A summary of the proposed works from 2010 to 2015 in the South planning area is outlined in the following table.

| Year | Proposed Project | Proposed Outcomes |
|---|---|---|
| 2012 | Establish Browns Road zone substation | |
| 2015 | Upgrade Kermandie terminal substation | Replace ageing 110/11 kV transformers and increase firm capacity at Kermandie. Load transfers defer capacity limitation at Knights Rd |

Further details of these and other potential long term projects in the HE area are discussed in Appendix A below.

## 8. MEDIUM TERM PLAN (5 TO 10YR)

The South Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30103849-South strategic plan Rev_3.

A summary of the proposed works from 2016 to 2020 in the South planning area is outlined in the following table.

| Year | Proposed Project | Proposed Outcomes |
|---|---|---|
| 2017 | Establish Blackmans Bay zone substation | Deload Kingston terminal substation |

[3] Data sourced from NW-#30075639-Statewide Distribution Transformers Customer Count Nov 09. Transformer data extracted from Gtech in November 2009.

Further details of these and other potential long term projects in the HE area are discussed in Appendix B below.

## 9. LONG TERM PLAN (10YR+)

The South Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30103849-South strategic plan Rev_3.

A summary of the proposed works from 2021 to 2050 in the South planning area is outlined in the following table.

| Year | Proposed Project | Proposed Outcomes |
|---|---|---|
| 2024 | Upgrade Knights Rd terminal substation | Replace ageing 110/11 kV transformers and increase firm capacity at Knights Rd. Load transfers from Electrona to Knights Rd to defer Electrona capacity limitation |
| 2030 | Upgrade Kingston terminal substation | Replace ageing 110/11 kV transformers and increase firm capacity at Kingston. |
| 2034 | Establish Margate zone substation | Deload Electrona and Kermandie substations |
| 2036 | Upgrade Kingston Terminal-33kV substation | Increase the capacity of Kingston terminal-33kV substation |
| 2040 | Upgrade Kermandie substation and second 110 kV Knights Rd – Kermandie transmission line | Increase firm capacity at Kermandie |
| 2040 | Upgrade Browns Rd zone substation | Increase group firm capacity |
| 2046 | Blackmans Bay zone substation | Upgrade Increase group firm capacity |

Further details of these and other potential long term projects in the HE area are discussed in Appendix C below.

# 10. PROGRAM OF WORK DRAFT

| Project | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 |
|---|---|---|---|---|---|---|
| Install UG HV - 6 feeder tails New Norfolk Zone | | $ 173,000 | | | | |
| (Project BW 006] Install 0.2 km HV UG Huntingtier Rd PID 221007 to Hardwicks Rd Bagdad PID 390836 | $ 80,000 | | | | | |
| Augment OH HV - 14 Mile Rd, Tarraleah | | | | | $ 210,000 | |
| Augment OH HV - Fdr 37002 stage 1 Gretna Zone associated with Zone replacement | | | | | $ 411,000 | |
| Augment OH HV - Fdr 37002 stage 2 Gretna Zone associated with Zone replacement | | | | | $ 411,000 | |
| Augment OH HV - Fdr 37002 stage 3 Gretna Zone associated with Zone replacement | | | | | $ 206,000 | |
| Derwent Bridge - Install 3rd wire Lyell Hwy (generator stability) 2 kms | $ 40,000 | | | | | |
| Derwent Bridge - Install permanent connection point generator | $ 25,000 | | | | | |
| Install 1 x 6.6/ 22 kV step up stations at todds corner | | | | | | $ - |
| Install 19/3.25 AA OH link Hamilton - F45003 2 kms | $ 130,000 | | | | | |
| Install OH HV - Auburn Rd to Macquarie Rd | | | | | | |
| Install OH HV - Derwent Bridge to Bronte Link | | | | | $ 630,000 | |
| Install OH HV - link Meadowbank 45003 to Wayatinah 49412 to Tunagtinah 49305 | | | | | | $ 420,000 |
| Install OH HV - link to Lake Cresent 3 ph (to assist in removal of SWER) | | | | $ 630,000 | | |
| Install OH HV - link Victoria Valley SWER to Tungatinah fdr 49303, Dee Lagoon | | | | | $ 124,000 | |
| Install OH HV - new Feeder, Elderside | | | | | | $ - |
| Install OH HV - Upgrade SWER, Dee Lagoon Link, Victoria Valley Rd | | | | $ 294,000 | | |
| Project BW 004 Reinsulate7.6 k & 8 tx Bridgewater F48 190 to 22 kV and supply from Meadowbank TS | $ 300,000 | | | | | |
| Project BW 005 Reinsulate 10.0 k &11 tx Bridgewater F 48 190 to 22 kV and supply from Meadowbank TS | | $ 352,000 | | | | |
| Project MB 001 - Westerway 38002 OH conversion to 22 kV (10 km OH and 15 tx's) | | $ 400,000 | | | | |
| Project MB 002 - Westerway 38002 OH conversion to 22 kV (12 km OH and 22 tx's) | | | $ 460,000 | | | |
| Project MB 003 - Westerway 38002 OH conversion to 22 kV (11 km OH and 15 tx's) | | | | | $ 360,000 | |
| Tods corner - Convert 6.6 kv line to 22 kv | | | | | | $ - |
| Augment pole sub 300 kVA First Avenue New Norfolk | $ 40,000 | | | | | |
| Augment pole sub Fairfax Terrace New Norfolk | $ 40,000 | | | | | |
| Install new pole sub George Street New Norfolk | $ 40,000 | | | | | |
| Install Substation - new or augment pole type 300 kVA | | | | $ 30,000 | $ 30,000 | $ 30,000 |
| Augment OH LV - overloaded LV ccts Highlands stage 2 | | $ 14,000 | | | | |
| Augment OH LV - overloaded LV ccts Midlands South stage 2 | | $ 14,000 | | | | |
| Augment OH LV - overloaded LV ccts Midlands South stage 3 | | $ 14,000 | | | | |
| Augment OH LV - overloaded LV ccts Midlands South stage 4 | | | | $ 14,000 | | |
| | $ 695,000 | $ 967,000 | $ 460,000 | $ 968,000 | $ 2,382,000 | $ 450,000 |



# 11. OPERATIONAL PLANS

- Contingency plans (not at operational level)

Operations Group have developed a number of contingency plans to define operational actions to be taken in the event of substation, busbar and feeder outages. The document NW-#30126392-Contingency Plan Register provides links to contingency plan documents as they are produced.

# 12. REFERENCE DOCUMENTS

Self explanatory but listed documents for system studies, council plans etc

- Listing of DINIS personal files
- Links to other work documents

# 13. NOTES

- System development plans identified for the area should link to other plans. Consultation with other work groups, in particular System Performance, Distribution Operations, Area Managers and key external stakeholders e.g. Councils and Government Departments, is essential to ensure optimum outcomes.
- It would be useful to include any details of reference documents and schematic diagrams indicating current substation layout and HV feeder arrangements.

# Appendix A. Short Term Plan (<5 years) – Constraints Options and Solutions

## A.1 Upgrade Kermandie terminal substation

### *A.1.1. Constraints*

Kermandie terminal substation is equipped with 2 x 10 MVA 110/11 kV transformers providing a firm capacity of 10 MVA. The transformers at Kermandie were installed in 1962 and Transend have indicated that these need to be replaced as soon as possible, with an estimated commissioning date of June 2015.

Knights Rd terminal substation is equipped with 2 x 20 MVA 110/11 kV transformers providing a firm capacity of 20 MVA. The transformers at Knights Rd were installed in 1987 which implies a nominal end of life in 2037.

The load at Knights Rd is forecast to exceed firm capacity in 2012 and the load at Kermandie is forecast to exceed firm capacity in 2019.



### *A.1.2. Options considered*

1. Upgrade Kermandie terminal substation and transfer load from Knights Rd
2. Upgrade Kermandie and Knights Rd terminal substations
3. Establish Franklin terminal substation and upgrade Kermandie terminal substation

**Option 1 (recommended option) – Upgrade Kermandie terminal substation and transfer load from Knights Rd**

This option involves the replacement of the existing 110/11 kV transformers at Kermandie with new 25 MVA units in 2015, with 11 kV load transfers from Knights Rd to Kermandie to deload Knights Rd deferring the firm capacity limitation at Knights Rd until 2024.

Augmentation of the Kermandie 11 kV network, including an additional Huon River crossing, will be required to fully implement these transfers.

The predominant cost of this project is expected to be the transformer replacement component, which is considered a refurbishment cost since it proposes the like-for-like replacement of an ageing asset.

The augmentation component of the project does not exceed $5M so a RIT is not required.

**Option 2 – Upgrade Kermandie and Knights Rd terminal substations**

This option involves the replacement on transformers at both Kermandie and Knights Rd terminal substations with 25 MVA units. This option avoids the 11 kV augmentation required under option 1 to transfer load from Knights Rd to Kermandie.

### Option 3 – Establish Franklin terminal substation and upgrade Kermandie terminal substation

This option involves the establishment of a new terminal substation in the vicinity of Franklin (equidistant from Kermandie and Knights Rd substations) to deload Kermandie and Knights Rd substations. The substation would be supplied from the existing 110 kV Knights Rd-Kermandie single circuit.

This option would also require the replacement of the ageing transformers at Kermandie substation in 2015; however they could be replaced with 10 MVA units (i.e. standard transformers without pumps/fans) as opposed to the 25 MVA units required under the other options.

This option would bring forward 110kV reinforcement to Kermandie, since load would be transferred from Knights Rd to Franklin substation, increasing load on the single circuit from Knights Rd and bringing forward the 25MW limitation on this feeder.



**Technical comparison**

| Option | Description | Advantages | Disadvantages |
|---|---|---|---|
| 1 | Upgrade Kermandie terminal substation and transfer load from Knights Rd | • Increases firm capacity at Kermandie by 15 MVA<br>• Optimally utilises existing assets<br>• Better balances the Kermandie and Knights Rd supply areas | • Increases load on the radial 110 kV feeder from Knights Rd to Kermandie |
| 2 | Upgrade Kermandie and Knights Rd terminal substations | • Increases firm capacity at Kermandie by 15 MVA and at Knights Rd by 5 MVA | • Fails to fully utilise existing Knights Rd transformers (25 years life remaining) |

| Option | Description | Advantages | Disadvantages |
|---|---|---|---|
| 3 | Establish Franklin terminal substation and upgrade Kermandie terminal substation | • Increases firm capacity in the Kermandie and Knights Rd area by 40 MVA.<br>• Results in shortest 11 kV feeders and hence best reliability of all options | • Increases load on the radial 110 kV feeder from Knights Rd to Kermandie, bringing forward 110 kV reinforcement<br>• Substation location not ideal to supply ultimate load<br>• Requires purchase and establishment of a new site |



**Cost comparison**

| Option | Initial Capital Cost ($M) | Total Capital Cost ($M) | Net Present Value ($M) |
|---|---|---|---|
| 1 | 6.2 | 12.2 | 6.9 |
| 2 | 11.0 | 11.0 | 8.0 |
| 3 | 23.5 | 29.5 | 18.1 |

The above cost comparison of options indicates that option 1 provides the lowest cost solution. Details of the NPV analysis are given in appendix B of NW-#30103849-South strategic plan Rev_3.

### *A.1.3. Possible Solution*

Based on the technical and cost comparison, option 1 is considered the preferred option to address the forecast limitations.

It is recommended that:

Transend:

- Recover the existing 2 x 10 MVA 110/11 kV transformers
- Install 2 x 25 MVA 110/11 kV transformers
- Connect new feeder tail to spare 11 kV CB at Kermandie

Aurora:

- Undertake network switching such that approximately 2 MVA is transferred from 30605 to 31010
- Undertake network switching such that the 31002 supplies the long section of 30607 to Deep Bay and Charlotte's Cover (approximately 2 MVA). This will require the installation of a new voltage regulator on 31002 in the vicinity of Lymington Rd.
- Run a new 11 kV feeder tail from Kermandie to the Huon River along the same route as 31002 (approximately 2 km overhead)
- Install a new sub-marine cable alongside the existing 31002 cable (approximately 1 km) and connect to 31002
- Undertake network switching such that the new feeder takes load from 30606 (approximately 2 MVA)

# Appendix B. Medium Term Plan (5 to 10 years) – Constraints Options and Solutions

## B.1 Establish Blackmans Bay zone substation

### *B.1.1. Constraints*

Kingston terminal substation is equipped with 2 x 35 MVA 110/11 kV transformers providing a firm capacity of 35 MVA. The transformers at Kingston were installed in 1980 which implies a nominal end of life in 2030.

The establishment of Browns Rd zone substation in 2012 provides Kingston terminal substation with support from the north, however both of these substations supply into the dense urban load from the outskirts of the town. It is expected that an injection point or significant 11kV augmentation will ultimately be required to service the load to the south of Kingston in the Blackmans Bay area.

The existing limitations on the Kingston 11 kV feeders which supply to the Blackmans Bay and Bruny Island areas will be addressed by a new feeder from Electrona substation in 2009/10, and by the establishment of Browns Rd in 2012. However load growth in the network is expected to justify additional 11kV injection in 2017.

The load at Kingston is forecast to exceed firm capacity in 2016. It is possible that this limitation could be deferred by load transfers to adjacent substations. However the combined load of Kingston and Browns Rd substations is forecast to exceed the combined firm capacity in 2017, which implies that additional firm capacity will be required in the area at this time.

The load at Browns Rd zone substation is forecast to exceed firm capacity in 2020.

### *B.1.2. Options considered*

1. Establish Blackmans Bay zone substation
2. Upgrade Kingston terminal substation
3. Install 3rd transformer at Browns Rd

**Option 1 (recommended option) – Establish Blackmans Bay zone substation**

This option involves the establishment of a new zone substation in the Blackmans Bay area supplied by 2 x 33 kV cables from Kingston terminal substation in 2017.

Blackmans Bay zone substation will consist of 2 x 25 MVA 33/11 kV transformers and two sections of 11kV switchgear. The substation will be

supplied transformer-ended from 33 kV cables from Kingston (approximately 4 km).

The 11 kV network would be reconfigured with minimal augmentation so as to deload the existing Kingston and Browns Rd 11 kV feeders. Kingston feeder 34251 would be split by a new cable tail from Blackmans Bay, providing improved reliability to Bruny Island and addressing the capacity limitations on 34251 and 34252.

**Option 2 – Upgrade Kingston terminal substation**

This option involves the replacement of the existing 2 x 35 MVA transformers at Kingston terminal substation with 60 MVA units in 2017.

This option would also require significant 11kV reinforcement into the Kingston and Blackmans Bay areas to address the feeder limitations.

**Option 3 – Install 3rd transformer at Browns Rd**

This option involves the installation of an additional 33/11 kV 25 MVA transformer at Browns Rd zone substation, supplied by a new 33 kV feeder from Kingston substation (approximately 5 km) in 2017.

This option would also require significant 11kV reinforcement into the Kingston and Blackmans Bay areas to address the feeder limitations.

**Technical comparison**

| Option | Description | Advantages | Disadvantages |
|---|---|---|---|
| 1 | Establish Blackmans Bay zone substation | • Increases group firm capacity by 25 MVA<br>• Results in shortest 11 kV feeders and hence best reliability of all options<br>• Optimally utilises existing assets | • Increases load on Kingston substation and advances firm capacity limitation<br>• Requires purchase and establishment of a new site |

| Option | Description | Advantages | Disadvantages |
|---|---|---|---|
| 2 | Upgrade Kingston terminal substation | • Increases group firm capacity by 25 MVA | • Fails to fully utilise existing Kingston transformers (15 years life remaining)<br>• Difficulty getting additional 11 kV feeders out of Kingston due to congestion<br>• Requires significant 11 kV reinforcement to Kingston/Blackmans Bay<br>• Substation location not ideal to supply ultimate load |
| 3 | Install 3rd transformer at Browns Rd | • Increases group firm capacity by 25 MVA | • Difficulty getting additional 11 kV feeders out of Browns Rd due to congestion Requires significant 11 kV reinforcement to Kingston/Blackmans Bay<br>• Substation location not ideal to supply ultimate load |



The above technical comparison of options indicates that option 1 provides the best technical solution.

**Cost comparison**

| Option | Initial Capital Cost ($M) | Total Capital Cost ($M) | Net Present Value ($M) |
|---|---|---|---|
| 1 | 12.6 | 18.1 | 9.6 |
| 2 | 10.5 | 28.1 | 12.4 |
| 3 | 11.3 | 21.8 | 11.7 |

The above cost comparison of options indicates that option 1 provides the lowest cost solution. Details of the NPV analysis are given in appendix B of NW-#30103849-South strategic plan Rev_3.

### *B.1.3. Possible Solution*

Based on the technical and cost comparison, option 1 is considered the preferred option to address the forecast limitations.

Therefore it is recommended to establish a zone substation at Blackman's Bay.

It is recommended that:

Transend:

- Terminate new 33 kV feeders to spare 33 kV CBs at Kingston terminal substation

Aurora:

- Install 2 x 25 MVA 33/11 kV transformers
- Install two sections of 11 kV switchgear, with two transformer CBs, twelve feeder CBs and a bus section CB inside a new switchgear building
- Install an underground 33 kV double circuit from Kingston to Blackmans Bay (approximately 5 km)
- Undertake 11 kV feeder works to split existing Kingston and Browns Rd feeders

# Appendix C. Long Term Plan (>10 years) – Constraints Options and Solutions

## C.1 Upgrade Knights Rd terminal substation

Load on Knights Rd substation is forecast to exceed firm capacity in 2012 and to reach 56 MVA by 2050.

The Knights Rd transformers are only 22 years old, so to get the maximum utilisation from the existing assets it is preferred that any transformer replacement be deferred as far as possible by transferring load to adjacent substations. This can be accomplished through the transfer of load to Kermandie substation, after its upgrade in 2015. In the years between the Knights Rd overload in 2012 and the Kermandie upgrade in 2015, the limitation at Knights Rd can be accepted, since load remains below the substation cyclic capacity.

To address the subsequent capacity limitation at Knights Rd it is recommended that the existing 2 x 20 MVA transformers be upgraded to 2 x 25 MVA units in 2024. It is also proposed that Knights Rd substation supply area be extended to the east towards Margate, to address capacity limitations at Electrona substation. This has been approximated as a 3MVA transfer in 2024; however in reality the transfer could be smaller or larger depending on load growth at Electrona substation. It is likely that 11kV feeder reinforcement from Knights Rd will be required at that time to transfer load from Electrona, but this is expected to be offset by the deferral of the Electrona substation upgrade or an additional zone substation.

## C.2 Upgrade Kingston terminal substation

The 110/11 kV transformers at Kingston terminal substation are forecast to reach end of life in 2030, based on a nominal 50 year lifespan. The group load on Kingston, Blackmans Bay and Browns Rd is forecast to exceed group firm capacity at approximately the same time.

Therefore it is recommended that the existing 35 MVA units be replaced with 2 x 60 MVA transformers in 2030. The transformers should be installed on the block adjacent to the existing substation site, allowing space for the subsequent installation of a third 110/33 kV transformer on the existing site.

An alternative option would be to establish a new Kingston zone substation on a nearby block, allowing space on the existing site for the installation of the third 110/33 kV transformer. This option also has the benefit that Aurora would have control over the 11 kV injection at Kingston, simplifying the operation of the network and the establishment of future 11 kV feeders. However this option has not been recommended for the following reasons:

- It would bring forward the installation of the third 110/33 kV transformer at Kingston

- The load on the Kingston, Browns Rd and Blackmans Bay substations are all forecast to be close to firm capacity in 2030. Replacing the existing 35 MVA transformers at Kingston with 25 MVA units would result in a deficit in firm capacity, which would require an additional zone substation establishment or upgrade to address

- It is likely to be a more costly option than a simple transformer replacement

Therefore, unless there are significant costs involved in fitting the three 110/33 kV and two 110/11 kV transformers on the existing site, the 110/11 kV transformers are recommended over the 33/11 kV option.

### C.3 Establish Margate zone substation

Electrona is forecast to exceed firm capacity in 2034, following the load transfers to Knights Rd.

To address this limitation it is proposed that a zone substation be established in the Margate area to deload Electrona. Margate zone substation will consist of 2 x 25 MVA 33/11 kV transformers, fed from 2 x 33 kV feeders from Kingston 33 kV substation.

Kermandie substation is forecast to exceed firm capacity in the same year; however this limitation may be deferred by several years through load transfers to Electrona after the establishment of Margate. It is likely that 11kV feeder reinforcement from Electrona will be required at that time to transfer load from Kermandie, but this is expected to be offset by the deferral of the Kermandie upgrade, especially considering the 110 kV reinforcement required as part of that project.

### C.4 Upgrade Kingston Terminal-33kV substation

Kingston terminal 33kV substation is forecast to exceed firm capacity with the installation of Margate zone substation in 2034, however it is expected that this limitation could be deferred for several years by load transfers from zone substations to Kingston terminal substation.

Therefore it is proposed that an additional 60 MVA 110/33 kV transformer be installed at Kingston in 2036.

### C.5 Upgrade Kermandie substation and second 110 kV Knights Rd – Kermandie transmission line

The Knights Rd – Kermandie 110 kV transmission line has a winter rating of 53 MVA and supplies Kermandie terminal substation as well as the direct connection customer substation at Huon River.

Taking supply from a single transmission this single transmission line exposes Kermandie to the risk of loss of supply in the event of a feeder fault, and makes maintenance or replacement of the line very difficult.

Plans are in place to upgrade Kermandie substation in 2015 to address loading issues but Kermandie is forecast to exceed firm capacity again in 2040. To address this limitation it is proposed that the 25 MVA transformers be replaced with 60 MVA units. At this time the second 110 kV Knights Rd-Kermandie transmission line could be justified for N-1 security at Kermandie, as the load will be greater than 25 MVA. At this point 110kV network augmentation is required to meet the ESI 25 MW regulation. The existing towers are double circuit construction which will aid in the construction of the second circuit.

### C.6 Upgrade Browns Rd and Blackmans Bay zone substations

The group load of Kingston terminal substation and Browns Rd, Blackmans Bay and Margate zone substations is forecast to exceed firm capacity in approximately 2040. The addition of approximately 50 MVA of firm capacity is required in the Kingston area by 2050 to address the forecast load.

To address this limitation it is proposed that a new 25 MVA 33/11 kV transformers be installed at the existing Browns Rd and Blackmans Bay substations, supplied from a new 33 kV feeders from Kingston 33 kV substation.

The upgrades would be required in 2040 and 2046 and the order of the projects would depend on the load development in the respective supply areas.

A new zone substation in the Kingston area would also be a potential solution, however given that the load in the area is quite dense and the existing substations are located in close proximity to each other, it is expected that the upgrade of an existing zone with 11kV reinforcement would be a lower cost option. Should the new zone substation be justified, it may be possible to install 33kV switchgear at Browns Rd and Blackmans Bay and supply the new zone by installing a single 33 kV cable from each.

# Appendix D. Technical Data

## D.1 Substation loading

Reference master document # 30006462

## D.2 Aurora Zone Substation data sheet

None in this area

Reference master document #30040697

## D.3 Transend Station data sheet

| Planning Area | Connect Point Substation | Connection Company | Connection Voltage kV | No. Of Connection Points | Type |
|---|---|---|---|---|---|
| South | Electrona | Transend Networks | 11 | 5 | Distribution |
| South | Kermandie | Transend Networks | 11 | 4 | Distribution |
| South | Kingston | Transend Networks | 11 | 12 | Distribution |
| South | Knights Rd | Transend Networks | 11 | 8 | Distribution |

Reference master document #30040697



## D.4 High Voltage feeder loading

2008/09

| Planning Area | Station | Feeder Number | Voltage | Sum of MD (MVA) | Planning Std (MVA) | Load in 5 years (MVA) |
|---|---|---|---|---|---|---|
| Central | Fisher | 3 (C252) | 11 | 0.9 | 5 | 1.0 |
| | | 4 (D252) | 11 | 0.0 | 5 | 0.1 |
| | Meadowbank | 45001 | 22 | 1.6 | 10 | 1.9 |
| | | 45002 | 22 | 2.1 | 10 | 2.4 |
| | | 45003 | 22 | 3.2 | 10 | 3.6 |
| | New Norfolk (Terminal) | 39563 | 22 | 7.5 | 10 | 8.3 |
| | | 39565 | 22 | 6.2 | 10 | 6.9 |
| | | 39568 | 22 | 2.3 | 10 | 2.6 |
| | | 39569 | 22 | 0.1 | 10 | 0.2 |
| | | 39570 | 22 | 6.1 | 10 | 6.8 |
| | | 39571 | 22 | 3.6 | 10 | 4.0 |
| | New Norfolk (Zone) | 35010 | 11 | 2.9 | 5 | 3.2 |
| | | 35011 | 11 | 2.3 | 5 | 2.7 |
| | | 35012 | 11 | 2.3 | 5 | 2.6 |
| | Tungatinah | T8&T9 | 22 | 1.4 | 10 | 1.6 |
| | Waddamana | 202 | 22 | 0.6 | 10 | 0.7 |
| | Wayatinah | 1 | 0 | 0.0 | 0 | 0.1 |
| | | 2 | 0 | 0.0 | 0 | 0.1 |
| | | 3 | 0 | 0.0 | 0 | 0.1 |

Reference master document #30040697



## D.5 Transfer Capacity

- MD transfer capacity with other stations (order of)
- 
- 
- Brief outline of transmission and subtransmission feeder arrangements, ratings and capabilities

Note it would be useful to include any details of reference documents and schematic diagrams

- HV feeder ratings, current summer and winter loads. MD's
- Provide high and low load forecasts i.e. +/- 10% of base load as above for each HV feeder for the next 10 years
- Indicate anticipated summer and winter load growths for each of the existing HV feeders in the area including ratings of the feeder.
- As above for major zones
- Reference Transend Annual Planning Report.

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# Appendix E. Planning Criteria and Guidelines

## E.1 Transmission Planning Criteria

Transend's planning criteria are fundamentally based on:

- the National Electricity Rules (NER);
- the Electricity Supply Industry (Network Performance Requirements) Regulations 2007; and
- good electricity industry practice

The following criteria are used when planning for the transmission system.

*Transmission and transformer loading*

- Transmission lines and autotransformer loadings for an intact system or for a contingency (N–1) should not exceed their continuous ratings in planning studies. For supply transformers four-hour emergency ratings can be used to defer augmentations depending on the peak duration of the load duration curve.
- Transmission line loading on circuits covered by NCSPS should not exceed 95 per cent of their rating for an intact system when Basslink is exporting. When Basslink is not in service or importing, standard N–1 criteria applies.

*Load interruptions*

For an intact system, i.e. where no elements are out of service for maintenance the following should apply as per Network Performance Requirements:

- no credible single contingency event will interrupt more than 25 MW load;
- no single asset failure will interrupt more than 850 MW or, in any event cause a system black;
- the unserved energy to loads interrupted as a result of damage to a network element related to a credible contingency event must not exceed 300 MWh; and
- the unserved energy to loads interrupted as a result of a single asset failure must not exceed 3,000 MWh

Single asset failure that would cause large load interruptions is the loss of a double circuit line, a bus section fault or a bus coupler fault. In calculating unserved energy, the ability to transfer load and the time required for load restoration should be taken into account.

*Exposure due to maintenance outage*

- Where a network element has been withdrawn from service for maintenance, replacement or repair, the energy exposed to interruption by a credible contingency event must not exceed 18,000 MWh.

In calculating unserved energy, the ability to transfer load should be taken into account.

*Maximum repair / replacement time*

Minimum Performance Requirements state that for the purpose of calculating unserved energy, any replacements or repairs undertaken, should not exceed the following:

- Transmission line repair – 48 hours
- Transformer replacement – 8 days
- Auto transformer replacement – 18 days



## E.2 Distribution Planning Criteria

Key planning standards include: -

*System Performance*

- Voltage regulation range of + 6% and – 6% of the nominal HV voltage and a LV voltage range of 230/400 V +10% and –2%;
- Power quality standards are recognised in accordance with the TEC, NER and applicable Australian Standards; and
- Tasmanian Reliability Performance Standards

Table Appendix E -1 Tasmanian Reliability Performance Standards

| Community category | Frequency standard (Maximum average number of supply interruptions per year) | | Duration standard (Maximum total time without electricity in a year measured in minutes) | |
|---|---|---|---|---|
| | For the category | For each community | For the category | For each community |
| Critical infrastructure | 0.2 | 0.2 | 30 | 30 |
| High density commercial | 1 | 2 | 60 | 120 |
| Urban and regional centres | 2 | 4 | 120 | 240 |
| Higher density rural | 4 | 6 | 480 | 600 |
| Lower density rural | 6 | 8 | 600 | 720 |

*Source: Tasmanian Electricity Code*



*Capacity*

Maximum average loading considerations for distribution feeders facilitating HV feeder interconnectivity;

- 22 kV – 10 MVA continuous and 15 MVA (typically one hour) emergency;
- 11 kV - 5 MVA continuous and 7.5 MVA (typically one hour) emergency.

*Security of supply*

Group firm philosophy or a deterministic planning standard, e.g. “N-1”, dependent on elements of security, load and exposure to risk

Schedule 5.1.2.2 (a) of the NER states:

> *“In the satisfactory operating state, the power system must be capable of providing the highest reasonably expected requirement for power transfer (with appropriate recognition of diversity between individual peak requirements and the necessity to withstand credible contingency events) at any time.”*