Standard

Switchyard Conductor Current Rating Standard

R517375

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Authorisations

Action	Name and title	Date
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Review cycle	30 months	

Responsibilities

This document is the responsibility of the Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Strategy Leader with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

Minimum Requirements

The requirements set out in TasNetworks' documents are minimum requirements that must be complied with by all TasNetworks team members, contractors, and other consultants.

The end user is expected to implement any practices which may not be stated but which can be reasonably regarded as good practices relevant to the objective of this document.

Record of revisions

Section number	Details
Entire doc	Copied over verbatim from superseded Transend to TasNetworks template. Updated Transend to TasNetworks document reference numbers where known including Australian Standards.

Table of contents

1 General

1.1 Purpose

The purpose of this document is to set out the parameters and procedures for establishing the rating of TasNetworks Transmision Substation switchyard conductors, including busbars.

1.2 Scope

It is intended that this standard will apply to all conductors from the transmission line termination through to the customer's termination at the supply connection .

1.3 Objective

The objective of this standards is to:

(a) set out the parameters to be used when rating switchyard busbars and conductors; and

(b) establish the procedure to be used when rating/re-rating switchyard busbars and conductors.

1.1 Definitions

Ambient Temperature – The prevailing air temperature existing at the time under consideration (in degrees Celsius).

Highest Daily Maximum Temperature – The maximum temperature recorded at the nearest official Bureau of Meteorology recording station.

Maximum Conductor Temperature – The maximum temperature that the metal conductor is allowed to attain without exceeding an approximate loss of strength of 3 per cent of the original tensile strength after 1000 hours operation at this temperature. This temperature equals 100°C in accordance with ENA C(b)1-2006 Appendix D Clause D2.2 – 'Maximum design operating temperatures'.

Mean 9 am Air Temperature – The Mean 9 am Air Temperature recorded at an official Bureau of Meteorology recording station nearest to the substation being rated.

Mean 3 pm Air Temperature – The Mean 3 pm Air Temperature recorded at an official Bureau of Meteorology recording station nearest to the substation being rated.

Maximum Demand (Domestic) – The maximum demand on a station occurring as a morning peak usually between 8:30 and 9:00 am. (Radial and most 110 kV stations.)

Maximum Demand (Commercial) – The maximum demand on a station occurring as an afternoon peak usually about 3:00 pm. (220 kV and 110 kV supporting Basslink.)

Solar Radiation – The relative solar heating gain as specified in the AEMO Workbook.

Switchyard Busbars and Conductors – Any bare stranded, solid or tubular conductor used to interconnect any two or more items of electrical apparatus (excluding insulated cable).

Wind Speed and Direction – The apparent wind speed and directions for the prevailing ambient air temperature as specified in the AEMO Workbook.

1.2 References

1.2.1 TasNetworks standards

TasNetworks Ratings - AEMO Workbook

Transmission Line Rating guideline - R90991

1.2.2 Other references

Overhead Transmission Line Thermal Calculator

Bureau of Meteorology (B.O.M) - Climate averages charts

WASP – Busbar and Conductor category

ENA C(b)1-2006 Appendix D Clause D2.2 – 'Maximum design operating temperatures'

2 Rating

2.1 General

An examination of the system loading shows that there are two distinct periods of peak demand described and then the industrial load:

(a) The first is called 'Domestic' that occurs as a morning peak usually between 8:30 and 9:00 am during the winter months. Maximum recorded air temperatures for this period are close to 11°C in highland areas and 14 – 16°C in lowland and coastal areas. Most of the 110 kV circuit connections fall into this category.

(b) The second is called 'Commercial' which encompasses the feeds to Basslink and generation inputs usually occurring between 2:30 and 3:00 pm during the summer months. Maximum recorded air temperatures for this period are close to 30°C in highland areas and 35 to 40°C in coastal and lowland areas. This applies to all the 220 kV circuit connections together with a couple of 110 kV circuits.

The industrial load is regarded as continuous 24 hours per day / 7 days per week / 52 weeks per year. This together with Substation Weather Centres and the Bureau of Meteorology (B.O.M.) - Climate averages charts leads to the following recommendations:

(c) For 'Domestic' loading use an ambient of 15°C.

(d) For 'Commercial' loading and 'Industrial' use an ambient of 30 - 40°C as appropriate for the maximum temperature recorded at the designated recording station (refer Substation Weather Centres).

When rating bay conductors, and where there are different size conductors in the bay, the minimum bay conductor size is taken as the rating of the whole bay.

2.1 Applying the thermal calculator

2.1.1 Wind speed and direction

The wind speed and direction figures to be used are those used in the AEMO Workbook for the same conditions.

2.1.2 Solar radiation (direct/difuse)

The solar radiation figures to be used are those used in the AEMO Workbook for the same conditions.

2.1.3 Ambient temperature

The following condition parameters must be applied when determining the ambient temperature:

(a) The ambient temperature to be applied ties in with the type of loading ie. whether it occurs in the am or pm and where the substation is located ie. highlands, lowlands or coastal;

(b) A check of the Bureau of Meteorology - Climate averages charts shows that irrespective of locality the maximum winter 9 am temperature is in the low teens so an ambient of 15ºC is used; and

(c) A check of the 3 pm charts shows a pattern for highlands, lowlands or coastal regions. The highland stations have a maximum in the high twenties so an ambient of 30ºC is applied, the lowland stations (eg. Palmerston) generally have a maximum in the high thirties so an ambient of 40ºC is applied and the coastal stations are in the mid-thirties so an ambient of 35ºC is applied.

A listing of the appropriate temperatures and the official weather stations referred to is tabulated in Appendix A: Substation – Weather Centre/Temperatures .

The ratings for the various conductors used in substations are tabulated in Appendix B: Substation Conductor Ratings.

3 Appendices

3.1 Appendix A: Substation – Weather Centre/Temperatures

Substation – Weather Centre/Temperatures

Station	Use Weather Station	AM	PM	Maximum	
Arthurs Lake	Liawenee	11.7	17.3	35.0	2003*
Avoca	Fingal	15.6	21.7	41.3	
Boyer	Bushy Park	15.7	22.2		
Bridgewater	Hobart	16.6	19.7	40.8	
Burnie	Burnie	16.9	19.9	33.8	
Chapel Street	Hobart	16.6	19.7		
Creek Road	Hobart	16.6	19.7	40.8	
Derby	Scottsdale	16.3	21.6	37.7	
Derwent Bridge	Lake St Clair	11.2	17.2	33.0	
Devonport	Devonport	16.8	20.2	33.2	
Electrona	Grove	15.8	20.9	40.4	
Emu Bay	Burnie	16.9	19.9	33.8	
Farrell	Queenstown	13.7	20.1		1995*
George Town	Low Head	16.6	19.8		2001*
Gordon	Strathgordon	12.8	17.9		
Hadspen	Launceston	16.6	23.2		
Hampshire	Burnie	16.9	19.9	33.8	
Huon River	Geeveston	15.3	20.3	39.5	
Kermandie	Geeveston	15.3	20.3	39.5	
Kingston	Hobart	16.6	19.7	40.8	
Knights Road	Grove	15.8	20.9	40.4	
Liapootah	Tarraleah	11.4	17.9		
Lindisfarne	Hobart	16.6	19.7	40.8	
Meadowbank	Bushy Park	15.7	22.2	39.5	
Mornington	Hobart	16.6	19.7	40.8	
Mowbray	Launceston	16.6	23.2	39.9	
New Norfolk	Bushy Park	15.7	22.2	39.5	
Newton	Queenstown	13.7	20.1		1995*
North Hobart	Hobart	16.6	19.7	40.8	
Norwood	Launceston	16.6	23.2	39.9	
Paloona	Devonport	16.8	20.2		
Palmerston	Cressy	16.8	23.3		
Port Latta	Smithton	16.4	20.3		
Que	Queenstown	13.7	20.1		
Queenstown	Queenstown	13.7	20.1		1995*

Railton	Devonport	16.8	20.2		
Risdon	Hobart	16.6	19.7		
Rokeby	Hobart	16.6	19.7	40.8	
Rosebery	Queenstown	13.7	20.1		1995*
Savage River	Luncheon Hill	14.0	19.4		
Scottsdale	Scottsdale	16.3	21.6	37.7	
Sheffield	Sheffield	15.1	20.1		
Smithton	Smithton	16.4	20.3	36.6	
Sorell	Hobart Airport	16.6	20.6	40.1	
St Leonards	Launceston	16.6	23.2		
St Marys	Scamander	16.6	19.9	42.2	
Tarraleah	Tarraleah	11.4	17.9		
Trevallyn	Launceston	16.6	23.2		
Triabunna	Orford	16.8	20.2	38.8	
Tungatinah	Tarraleah	11.4	17.9		
Ulverstone	Devonport	16.8	20.2	33.2	
Waddamana	Liawenee	11.7	17.3	35.0	
Wesley Vale	Devonport	16.8	20.2	33.2	

* Data only available up to the stated date

AM mean = 16±^{o}C Use 15^{o}C Table

PM mean = 23±^{o}C Use 25^{o}C Table

Maximum Recorded

- Inland Low Altitude = 40^{o}C
- Inland High Altitude = 35^{o}C
- Coastal = 42.2^{o}C

http://www.bom.gov.au/climate/data/index.shtml?bookmark=201

3.1 Appendix B: Substation Conductor Ratings

Bus, Bay and Dopper Conductors

Wind Speed / Angle		0.5 / 90	0.5 / 90	0.5 / 90	0.5 / 90	0.5 / 90	0.5 / 90	0.8/60	1.25/45	1.5/45
Solar Radiation (Direct / Difuse)		60/10	605/65	860/95	900/100	910/105	960/110	960/110	960/110	960/110
Conductor Name/ Make-up	Material	ambient 0° C,	ambient 5° C,	ambient 10°C,	ambient 15°C,	ambient 20°C,	ambient 25°C,	ambient 30°C,	ambient 35°C,	ambient 40°C,
KRYPTON	AAAC/1120	730	680	650	625	605	580	595	605	600
NITROGEN	AAAC/1120	1015	945	895	865	835	800	820	830	825
SELENIUM	AAAC/1120	1555	1435	1355	1310	1265	1210	1240	1250	1235
SPINEL	AAAC/6201	1485	1370	1295	1250	1210	1155	1185	1190	1180
SULPHUR	AAAC/1120	1870	1720	1625	1565	1510	1445	1480	1490	1475
61/.125	AAC	1520	1400	1315	1265	1220	1170	1195	1200	1190
61/.173	AAC	2500	2300	2160	2080	2000	1920	1960	1970	1980
MAYBUG (37/4.09)	AAC	1520	1400	1315	1265	1220	1170	1195	1200	1190
TAURUS	AAC/1350	1210	1125	1065	1025	995	950	975	985	975
URANUS	AAC/1350	1575	1455	1375	1325	1280	1225	1255	1265	1250
VENUS	AAC	1895	1750	1645	1585	1530	1465	1500	1510	1495
BITTERN	ACSR	1780	1635	1535	1480	1425	1360	1400	1400	1390
CHERRY	ACSR	570	535	505	485	470	450	465	470	470
DOG	ACSR	570	535	505	485	470	450	465	470	470
GOAT	ACSR	1220	1130	1070	1035	1000	955	980	985	980
HYENA	ACSR	565	535	500	480	465	445	460	465	460
Wind Speed / Angle		0.5 / 90	0.5 / 90	0.5 / 90	0.5 / 90	0.5 / 90	0.5 / 90	0.8/60	1.25/45	1.5/45
Solar Radiation (Direct / Difuse)		60/10	605/65	860/95	900/100	910/105	960/110	960/110	960/110	960/110
Conductor Name/ Make-up	Material	ambient 0° C,	ambient 5° C,	ambient 10°C,	ambient 15°C,	ambient 20°C,	ambient 25°C,	ambient 30°C,	ambient 35°C,	ambient 40°C,

IBIS	ACSR	885	825	780	755	730	700	720	725	720
OLIVE	ACSR	1520	1400	1315	1265	1220	1170	1195	1200	1190
ORTOLAN	ACSR	1570	1450	1365	1315	1265	1210	1240	1250	1235
TERN	ACSR	1335	1235	1165	1125	1085	1040	1065	1070	1065
54/3.175-7/3.179	ACSR	1485	1370	1300	1255	1210	1160	1190	1195	1180
7/.104	HDC	370	350	335	325	315	300	310	315	315
19/.083	HDC	535	505	480	465	450	435	445	450	450
19/.092	HDC	610	575	550	530	515	495	510	515	510
19/.116	HDC	825	775	735	710	690	660	680	685	685
37/.080	HDC	785	735	700	680	655	630	650	655	650
37/.083	HDC	840	785	750	725	700	675	695	700	695
37/.103	HDC	1100	1025	975	945	910	875	895	905	900

Notes:

(a) Maximum conductor temperature (100°C) in accordance with ENA C(b)1-2006 Appendix D Clause D2.2

(b) Figures are rounded to nearest 5 Amps

(c) Wind speed/angle & solar radiation in accordance with AEMO workbook figures

Solid/Tubular Busbars

		Rating at 80°C, 0.5 M/S Wind @ Right Angles and a mid-summers day								
		ambient 0° C,	ambient 5° C,	ambient 10°C,	ambient 15°C,	ambient 20°C,	ambient 25°C,	ambient 30°C,	ambient 35°C,	ambient 40°C,
3" x ¼" Bar	HDC	1575	1525	1475	1415	1355	1290	1220	1150	1080
4" x ¼" Bar	HDC	2015	1950	1885	1810	1730	1650	1560	1470	1385
60 x 10 Bar	HDC	1550	1500	1450	1390	1335	1270	1200	1130	1065
32mm OD x 3.25mm Tube	HDC	1050	1000	955	900	845	785	725	660	600

		Rating at 85°C, 0.6 M/S Wind @ Right Angles and a mid-summers day								
		ambient 0° C,	ambient 5° C,	ambient 10°C,	ambient 15°C,	ambient 20°C,	ambient 25°C,	ambient 30°C,	ambient 35°C,	ambient 40°C,
60mm OD x 5.5mm Tube	6101 T6 AL	2270	2180	2090	2000	1910	1815	1720	1620	1520
100mm OD x 4mm Tube	6101 T6 AL	2755	2635	2535	2425	2315	2200	2085	1965	1840
100mm OD x 6mm Tube	6101 T6 AL	3340	3200	3065	2935	2805	2670	2530	2380	2230
100mm OD x 10mm Tube	6101 T6 AL	4210	4040	3875	3710	3550	3375	3200	3010	2820
160mm OD x 10mm Tube	6101 T6 AL	6380	6130	5880	5630	5385	5120	4850	4570	4280
65 nb Tube	GMS						150			