Standard

Normative to AS/NZS 7000:2016 Overhead Line Design – Detailed Procedure

R1047190

Version 2.0, April 2021

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 Primary Systems 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

Version	Section number	Details
2.0	All	Normative revised to adopt AS/NZS7000:2016 (the **Standard**) as the TasNetworks specification of aspects with in transmission line design **Standard**. All design requirements previous specified in this document are now covered by the **Standard** or this normative.
2.0	7.2.2, Appendix 5	Higher transmission voltages added.
3.0	All	Document reviewed as part of review cycle.

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1 General

1.1 Purpose

This document is normative when applied to TasNetworks assets and informative for all other uses.

TasNetworks has prepared this document (henceforth referred to as Normative or the Normative) listing the TasNetworks normative aspects of Australian/New Zealand Standard AS/NZS 7000:2016 “Overhead line design” (henceforth referred to as the **Standard**).

This Normative has been prepared to specify TasNetworks design requirements for the determination of design actions where:

- TasNetworks requirement differs from the **Standard**
- TasNetworks has specific requirements for **Standard** clauses which are recommended or for consideration.
- The **Standard** does not sufficiently detail methods or parameter values to be used.

This document shall be read in conjunction with the **Standard**. All clause numbers used in this normative correspond to those of the **Standard**.

1.1.1 Interpreting this normative

Specific sub-clauses are prefixed TN are to be read as amendments/addendums to the relevant text in the **Standard**. The Table 1 below summarises the use of the TN prefix.

Table 1 Interpreting the normative

Example	Interpretation
TN 2.7 COORDINATION OF STRENGTH	TasNetworks has provided amendments/addendums to section 2.7 COORDINATION OF STRENGTH in AS/NZS 7000:2016
TN TABLE 7.1 LOAD CONDITIONS AND LOAD FACTORS	TasNetworks has provided amendments/addendums to Table 7.1 LOAD CONDITIONS AND LOAD FACTORS in AS/NZS 7000:2016
1.1 Purpose	This is a subheading within the TasNetworks Normative Document which is not part of AS/NZS 7000:2016
Table 2 Design Criteria	This is a table provided in the TasNetworks Normative Document as an amendment/addendum which is not a table as part of AS/NZS 7000:2016

Any necessary clarification regarding the application of this Normative in conjunction with the **Standard** shall be referred to TasNetworks who will clarify the requirements. Where no reference is made in the normative to a specific sub-clause, then the **Standard** shall apply.

The normative does not address conductor selection, electrical design, insulation co-ordination or sub-component design; these will be in accordance with the Electrical Design Standard and the applicable Australian Standards.

1.2 Deviations

Deviation to this normative is subject to TasNetworks written approval.

2 AS/NZS7000:2016 clauses affected by this normative

A summary of the clauses of AS/NZS7000:2016 affected by this normative document are contained below in Table 2.

Table 2 Summary of Clauses covered by this normative

Clause	Page	Title	Aspect
2.7	19	Coordination of strength	TasNetworks reliability philosophy
3.7.3	32	Conductors on the same supports	Allowing for live-line maintenance.
4.2.1	50	Limit states	Table 4.1 additional specification.
7.2.2	68	Wind Loads	TasNetworks design criteria for security, working life and minimum design return period.
7.2.3	68	Snow and ice loads	Specification of ice loading.
7.2.4.1	69	Forces due to short circuit currents	Specification of short circuit forces.
7.2.4.2	69	Avalanches and creeping snow loads	No design requirements
7.2.4.3	69	Earthquakes	No design requirements
7.2.5.1	69	General	Applicable load factor for construction and maintenance loads.
7.2.5.2	69	Loads related to line maintenance / construction personnel.	Un-factored personnel loading allowances.
7.2.6	70	Coincident temperatures	Specification of coincident temperatures for an expanded set of loading conditions.
7.2.7.2.1	71	General	Failure containment loads
7.2.7.2.3	71	Tension supports	Specification of the affected wires and design requirements.
7.2.7.2.5	72	Residual static load (RSL)	Calculation of RSL for conductors and earthwires.
7.2.7	70	Security loads	Table of security load
7.3.1	72	Loads from supporting wires	Specification weather and load conditions.
7.3.2.1	72	General	Coincident temperature and wind pressures for all design conditions.
7.3.2.2	72	Wind condition	Coincident temperature definition.
7.3.2.3	72	Maintenance condition	Coincident temperature and wind pressures.

Clause	Page	Title	Aspect
7.3.2.4	73	Everyday condition	Coincident temperature and wind pressures.
7.4.1	73	General	Load combinations across a structure
7.4.2	73	Deflection and serviceability limit state	Design criteria to limit deflections.
TABLE 7.1	74	Load conditions and load factors	Replacement table to TABLE 7.1 of the **Standard.**
Appendix B5.4	128	Wind forces on conductors.	Conductor wind drag coefficient.
Appendix DD		Easement Widths.	Specified in Appendix 5 of this document.

3 Normative to AS/NZS7000-2016

SECTION 2 DESIGN PHILOSOPHIES

TN 2.7 COORDINATION OF STRENGTH

TasNetworks has adopted the IEC reliability philosophy for transmission line strength coordination and an extract is provided in Appendix 1. This TasNetworks philosophy implies that in the event of a structure failure, its replacement can be erected on the same foundation.

SECTION 3 ELECTRICAL REQUIREMENTS

TN 3.7 SPACING OF CONDUCTORS

TN 3.7.3 Conductors on the same supports

TasNetworks require that all new transmission lines with voltages equal or greater than 220 kV will be designed to allow for helicopter live-line maintenance. In all cases the minimum vertical conductor spacing for helicopter live-line maintenance is 6 m at 220 kV unless specified otherwise by TasNetworks.

Overhead earth wire sag shall be designed as a ratio of the phase conductor sag. Where possible the ratio of earth wire sag to phase conductor sag which shall not be exceeded is 85 per cent at 15°C, unless specified otherwise or approved by TasNetworks.

SECTION 4 CONDUCTORS AND OVERHEAD EARTH WIRES (GROUND WIRES) WITH OR WITHOUT TELECOMMUNICATION CIRCUITS

TN TABLE 4.1 DAMAGE AND FAILURE LIMITS OF CONDUCTORS

Notes:

4: In addition, the initial conductor installation tension serviceability limits shall also be assessed against the Cigre WGB2.11.04 Technical Brochure 273 - Overhead conductor safe design tension with respect to Aeolian vibrations, Table 6.3. Exceedance of these Cigre limits shall be reported to TasNetworks for approval.

SECTION 7 ACTION ON LINES

TN 7.2 ACTIONS, GENERAL APPROACH

TN 7.2.2 Wind loads

Unless otherwise specified by TasNetworks, lines shall be designed/assessed for the following design criteria in accordance with clause 6.2.2 of the Standard.

Table 3 Design Criteria

Design Type	Design Criteria		Resulting minimum design return period (years)
	Line security level	Design working life	
Design of new DC lines up to 500kV DC	level III	50 years	200
Design of new 330 kV	level III	50 years	200
Design of new 275 kV	level III	50 years	200
Design of new 220 kV	level III	50 years	200
Design of new 110 kV	level II	50 years	100
Assessment of existing 220 kV	level II	50 years	100
Assessment of existing 110 kV	level I	50 years	50

Oblique wind shall be applied to in-line square based towers at 22.5deg to the transverse axis. An assessment of the critical angle of incidence shall be undertaken for square based angle towers and rectangular based towers.

In calculating the wind pressures on conductors and OPGW/EWs for tension determination and wind on attachment points, one of the following approaches shall be adopted:

- A common, weighted wire height (averaged over the span) shall be used for conductors and earth wires such that the resulting ground line moment is equivalent to the moment derived considering the respective height of each wire in the derivation of the wind pressures on each wire.
- A specific wind pressure shall be determined for the OPGW/EW based on its height averaged over the span, with a specific wind pressure for the conductors based on the weighted conductor height (averaged over the span).

TN 7.2.3 Snow and ice loads

TasNetworks has no snow load assessment requirement.

The maximum uniform ice loading actions on affected structures shall be determined in accordance with Appendix DD, and particularly Table DD2 of the Standard.

Affected structures shall be assessed for non-uniform ice accretions with the high accretion wires having 70%, and low accretion wires having 30%, of the maximum uniform ice weight. The distribution of high and low accretion wires shall be determined for two conditions:

Longitudinal: all wires on one span having the high accretion and all wires on the other span having low accretion. The high and low spans may need to be reversed for the critical condition:

Torsional: the critical arrangement of high and low accretion wires shall be selected on the basis of the maximum torsional action on the structure from conductors and earthwires combined, whilst limiting the low accretion wires to first the back and then the ahead span in turn. Double circuit structures shall be designed/assessed with either or both circuits strung.

TN 7.2.4 Special loads

TN 7.2.4.1 Forces due to short circuit currents

Landing spans of less that 100m shall be designed for short circuit forces. Wire forces shall be determined in accordance with IEC 608865 for applicable pinch, short circuit and drop effects. Landing gantries shall be assumed to be rigid unless a stiffness value is provided.

Applicable coincident temperatures and wind pressures are specified in Table 4.

Table 4 Short Circuit Forces

Short Circuit Condition	Coincident Temperature	Phase	Wind Pressure for Tension Effect	Wind Pressure on Conductor Effect
Pinch and Tensile	Minimum Temp Condition	Affected	Nil	0.25qz
		Unaffected	0.25qz	0.25qz
	Ice Condition	Affected	Nil	0.25qz
		Unaffected	0.25qz	0.25qz
Drop	Maximum Operating Temp Condition	Affected	Nil	0.25qz
		Unaffected	0.25qz	0.25qz

Refer to TN TABLE 7.1 for coincident temperatures

TN 7.2.4.2 Avalanches and creeping snow loads

TasNetworks has no requirement.

TN 7.2.4.3 Earthquakes

Tasmania is to be regarded as having a mildly active seismicity. TasNetworks have no design requirements.

TN 7.2.4.4 Other special loads

Additional project specific special loads may be required to be considered and will be specified in TasNetworks project scoping document.

TN 7.2.5 Construction and maintenance loads

TN 7.2.5.1 General

The applicable load factor for construction and maintenance loads, Q_m, is specified in TN TABLE 7.1. Designers shall provide a drawing specifying all construction and maintenance load constraints assumed in the derivation of the design loads to enable the contractor to safely perform construction and maintenance activities. Vertical and square rigging arrangements shall be included in the design/assessment. Some typical rigging scenarios which could lead to large member stresses, if all minute details are not examined or care to detail is not observed, are included in Appendix 2 of this normative.

The applicable design wind and temperature conditions are specified in TN TABLE 7.1. The applicable wires tensions for the construction and maintenance condition shall be the stringing tensions at the (structural) ambient temperature specified in TN TABLE 7.1.

Supports used as temporary dead-ends during stringing and sagging shall be capable of resisting the highest longitudinal loads resulting from the stringing/sagging tensions, in any combination of load and/or no load at the several support points that represent the conductor stringing sequences.

Temporary guys used to reinforce and obtain the required longitudinal strength on lattice structures, shall be adequately pre-stressed to account for the difference in deformation of the guys versus the relative rigid structure. The resulting increase in vertical load at these guy attachment points, and or the various components if these guys do not coincide with the temporary conductor dead-end, shall be assessed and conventionally combined with stresses, on structure members, present during the operation.

Suspension structures shall be designed / assessed for one wire being worked-on at a time. No phase conductors shall terminate, but structures shall be designed/assessed for stringing-to and stringing-through of any OPGW.

Strain structures shall be designed/assessed for one wire being worked-on at a time with any or all other phases and earth wires temporarily terminating.

Terminal structures shall be designed/assessed for one phase or earthwire /OPGW being worked-on at a time with any or all other phases and earth wires terminating.

TN 7.2.5.2 Loads related to line maintenance/construction personnel

The minimum un-factored personnel loading allowances shall generally be as specified in c7.2.5.2 of the **Standard**. In the case of small, light duty structures, where tower climbing is to be restricted, or prohibited, TasNetworks may specify reduced, or nil, personnel loading allowances.

Structures shall be designed/assessed for the provision of climbing anchorages with a load capacity of 15kN. Wire attachment points shall be assessed/designed for the maximum of the Standard personnel loading allowance and the climbing anchorage load.

Vertical and Delta structure members:

- above the level of the lowest cross arm (including cross arms, but excluding tie members) at less than 30° to horizontal shall be designed/assessed for the combined 1.5kN point load and coincident axial load under the construction and maintenance condition;
- below the level of the lowest cross arm at less than 30° to horizontal shall be designed/assessed for 1.5kN point load with no coincident axial load;

Flat spacing structure members:

- above the level of the throat at less than 30° to horizontal shall be designed/assessed for the combined 1.5kN point load and coincident axial load under the construction and maintenance condition; and
- below the level of the throat at less than 30° to horizontal shall be designed/assessed for 1.5kN point load with no coincident axial load.

TN 7.2.6 Coincident temperatures

Coincident temperatures for an expanded set of loading conditions are specified in TN TABLE 7.1.

Two ambient temperature sets are pertinent to line design/assessment:

Table 5 Coincident temperature

Condition	Basis	Temperature
Structural actions	Annual mean temperature (ref. Appendix A)	lowland - 10°C highland - 7°C
Conductor vibration condition	Mean temperature of the coldest month (July) (ref. Appendix A)	lowland – 4.5°C highland – 1.5°C

TN 7.2.7 Security loads

TN 7.2.7.2 Failure containment loads F_b

TN 7.2.7.2.1 General

Failure containment loads comprise two separate conditions:

- Loads on a structure arising from the failure of an adjacent structure will cause longitudinal out of balance (differential) loading across the structure; and
- Broken wire loads cause substantial torsional loading on the structure.

Fb and Ft tensions shall be based on the temperature and wind pressures specified here in TN TABLE 7.1.

TN 7.2.7.2.2 Suspension or intermediate supports

The affected wires and the design requirements are specified in Table 6.

In the case of single pole structures with ridged foundation which resist structure rotation, it is impractical to design for the cross arm to resist the imposed longitudinal tension. It is assumed that in the event of a broken conductor the cross arm will fail at the pole connection bolt thus releasing the high longitudinal load. Other components may need checking for their resulting loading and limits in this situation, e.g. cross arm section modulus, to ensure that this occurs prior to pole or foundation failure.

TN 7.2.7.2.3 Tension supports

The affected wires and the design requirements are specified in Table 6.

TN 7.2.7.2.5 Residual static load (RSL)

RSL factors for both conductors and earthwires on suspension structures shall be calculated in accordance with Figure 7.2.7.1.5

Where:

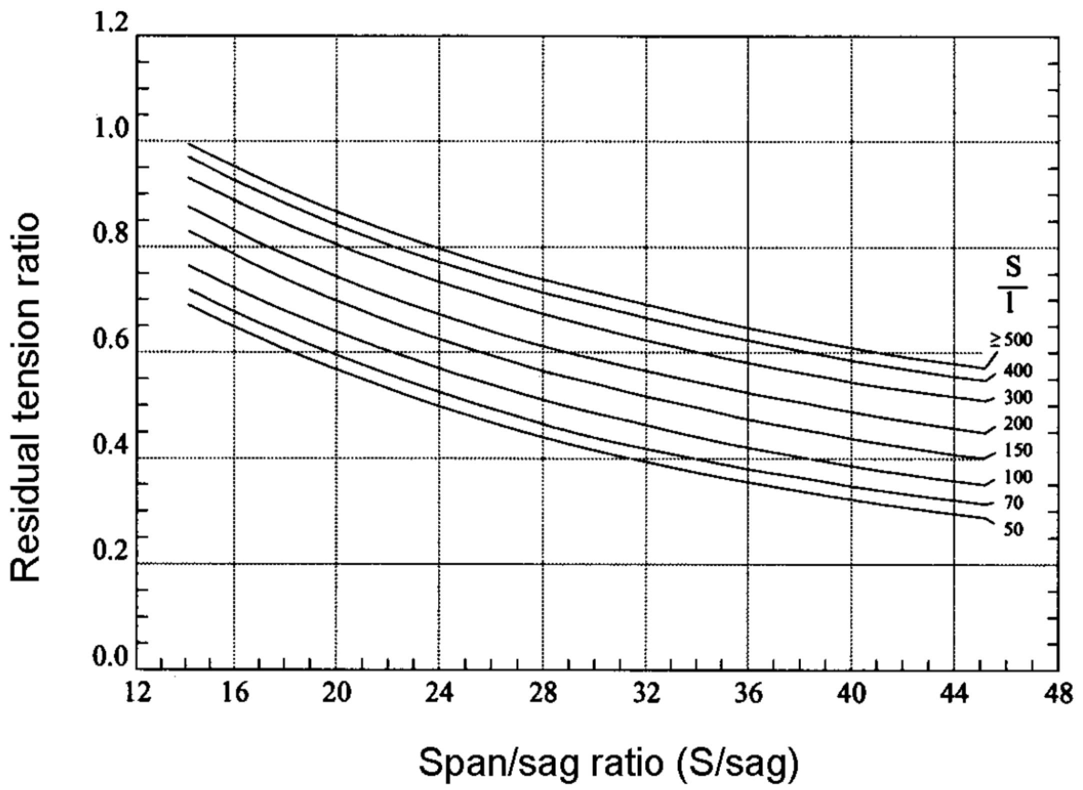
s = span length (m)

sag = the sag relating to the span (m)

l = insulator string length (m)

The minimum value shall be limited to 0.7 and tension structures shall not have RSL factors applied to the supported spans.

Figure 1 RSL Ratio



[1]

NOTE: While the equivalent span may be used to calculate tensions in a section of line, designers should be aware that if the span lengths in a line section have considerable variation, a RSL based on the equivalent span may underestimate broken conductor tensions for some spans.

[1] Source - ENA C(b)1—2006 Guidelines for design and maintenance of overhead distribution and transmission lines, Energy Networks Association 2006

Table 6 Security loads

Loading Condition	Support Type	Affected Wires	Requirement
Broken Wire	Suspension	S/C: 1/3 phases, or 1/3 EW's rounded up D/C: 1/3 phases + EW's rounded down	Summation of: • Weight span - 50% of intact span + 25% of broken span. • Transverse load - wind on 50% intact span + 25% broken span • Unbalanced RSL tension.
	Tension	1/3 phases, with/without 1/3 EW's rounded up	Summation of: • Weight span - 50% intact span + 25% broken span unless in uplift, in which case the uplifted span may require 0 or 25% of the broken span, whichever is critical • Transverse load - wind on 50% intact span + 25% broken span • Unbalanced tension.
Differential	Tension	All wires out of balance	Tension based on the greater of :- • Notional overweight condition (see note 1) • 50% of the higher stringing tension
	Suspension	All wires out of balance	Tension based on the lesser of :- • Notional overweight condition x greater of the ahead and behind RSL • 50% of the stringing tension
Stop	Tension	Any or all phases, with/without EW's	D/C supports: either or both circuits strung: • either circuit with/without earth wires broken, and • both circuits with/without earth wires broken S/C supports: • any or all phases, with/without earthwires broken

Note 1 - Notional overweight condition = (2 x weightspan1 tension) – (1 x weightspan2 tension)

TN 7.3 LOAD COMPONENTS

TN 7.3.1 Loads from the supporting wires

Unless otherwise specified in TasNetworks project scoping document, the suspension, strain terminating wire design/assessment requirements for the weather load conditions shall be:

- **Suspension structures** – all conductors and earthwires in suspension with OPGW either in suspension or strained off;
- **Stain structures** – all conductors, earthwires and OPGW strained off.

Terminal structures shall be designed for both a terminal and a strain condition unless otherwise specified.

- In the terminal condition, all conductors, earthwires and OPGW are to be capable of terminating on either span.
- In the strain condition all conductors, earthwires and OPGW to be strained off on both spans.
- Double circuit structures with either or both circuits strung, with none, either or all OPGW/EWs strung.

Refer to clause 7.2.5 for affected wires under construction or maintenance and clause 7.2.7 for the affected wires for security conditions.

TN 7.3.2 Conductor tensions

TN 7.3.2.1 General

Refer to TN TABLE 7.1 for coincident temperatures and wind pressures for all design conditions.

TN 7.3.2.2 Wind condition F_{tw}

Refer to TN TABLE 7.1 for coincident temperature.

Tension section reduction factors (TSRF) for conductors and OPGW/EWs shall be based on the total wire section length.

It can be expected that the conductor and OPGW section lengths will often be different as joint box locations will not necessarily coincide with tension structure locations.

TN 7.3.2.3 Maintenance condition F_{tm}

Refer to TN TABLE 7.1 for coincident temperatures and wind pressures for maintenance condition.

TN 7.3.2.4 Everyday condition F_{te}

Refer to TN TABLE 7.1 for coincident temperatures and wind pressures for everyday condition.

TN 7.4 LOAD COMBINATIONS

TN 7.4.1 General

Differential wire tensions across a suspension structure under maximum wind conditions shall be assessed when the span ratio exceeds 1:3 or when differences in terrain category, topography and/or line profile cause significant differential tensions across a suspension structure. This is also applicable where the insulator type does not easily allow equalisation of conductor tensions across the structure, e.g. semi-rigid composite post insulators.

TN 7.4.2 Deflections and serviceability limit state

Steel pole structures shall be designed to limit deflections for:

- Everyday condition: the lesser of 350mm and 2% of pole length.
- Strength limit states: 5% of pole length.
- No deflection limits are imposed on lattice structures.

TN TABLE 7.1 Load Conditions and Load Factors

TABLE 7.1 of the Standard shall be replaced with TN TABLE 7.1 Load Combinations and Design Values. TN TABLE 7.1 has been expanded to incorporate coincident temperature design values (refer clause TN 7.2.6).

TN TABLE 7.1 LOAD CONDITIONS AND LOAD FACTORS

Loading condition	Wn	Load factor and application						Coincident temperature	
		S_γ	G_s	G_c	F_t	F_b	Q	Requirement	Comment
Maximum wind and maximum weight	q_z (see Note 2)		1.1	1.25	1.25			Ambient + 10ºC	Unless otherwise advised, the ambient temperatures for actions on structures are: Lowlands regions = 10ºC Highlands regions = 7ºC Refer to clause TN 7.2.6
Maximum wind and minimum weight	q_z		0.9	0.0 (Note 1)	1.25			Ambient + 10ºC	
Maximum wind and uplift	q_z		0.9	1.25 (Note 1)	1.25			Ambient + 10ºC	
Minimum temperature	$0.36q_z$		1.1	1.25 (Note 1)	1.25			The closest recorded urban site temp from the BOM web site, less 0.01ºC/m elevation	
Every day (sustained loads)	100Pa		1.1	1.25	1.1			Ambient	
Snow and ice	Wires: 720Pa<150m<360Pa Structures: 720Pa with LF=1.0	1.0	1.1	1.25	1.75			-10ºC	
Failure containment	$0.25q_z$		1.1	1.25				Ambient	
- Intact tension, incl differential					1.25				
- Broken wire tension - *Standard*						1.25			
- stop						1.75			
Serviceability - deflection limit	(see Note 4)		1.1	1.1	1.0			Ambient	
Serviceability - vibration limit	(see Note 5)							Ambient	
Maintenance	100Pa		1.1	1.5 (Note 3)	1.5 (Note 3)		2.0	Ambient	
Short circuit	$0.25q_Z$ (see Note 6)				1.25			Refer Table 4	
Seismic - No Requirement									

TABLE NOTES:

1. Adequate allowance shall be made for differential loadings that can occur between adjoining spans at a structure particularly in mountainous terrain to allow for uplift loads under normal service conditions including low temperature effects.
2. Winds from transverse, longitudinal and 22.5o to transverse directions (for square based towers) shall be assessed. Refer to 7.2.2 for other than square based towers.
3. Conductor tension and weight of conductors under maintenance condition shall be treated as live loads Q with corresponding load factors of 2.0.
4. Refer to clause 7.4.2
5. The tabulated coincident temperatures are those temperatures referenced in Note 1 of Table Y1 of AS/NZS 7000:2016.
6. Applicable to landing spans when span <100m.

TN APPENDIX B – WIND LOADS

TN B5 WIND PRESSURE

TN B 5.4 Wind forces on conductors

The conductor drag coefficient, C, for TasNetworks lines shall normally be taken as 1.0.

Except with rime hard ice accretion where C shall be taken as 1.1.

For the ultimate limit state span pressure calculations, the minimum recommended conductor design pressure inclusive of any SRF, shall be 500Pa for spans 300m and longer, and shall be 900Pa for spans shorter than 150m and this pressure is increased linearly between these two span length limits.

TN APPENDIX CC – EASEMENT WIDTHS

TN CC1 Easement width

Easement width of TasNetworks lines shall be in accordance with Appendix 5 of this normative document.

Appendix 1 Strength Coordination

The typical strength co-ordination recommended by IEC 60826:2017 Table 17, is reproduced below.

This table provides first for the strength coordination between major components and, subsequently, provides for a subsequent coordination within the various elements of a major component (support is renamed here as tower).

	Major Component	**Co-ordination within major component***
Less reliable (first component is likely to fail when limit loads are exceeded).	Suspension tower	Tower, foundations, interfaces (hardware)
More reliable with 90 % confidence	Tension tower	Tower, foundations, interfaces (hardware)
	Dead-end tower	Tower, foundations, interfaces (hardware)
	Conductors**	Conductors, insulators, interfaces (hardware)

* Within each major component, the underlined component is the least reliable with 90 % confidence.

** With the strength limits specified in Table 20 of this standard, conductors are usually the most reliable component of the line.

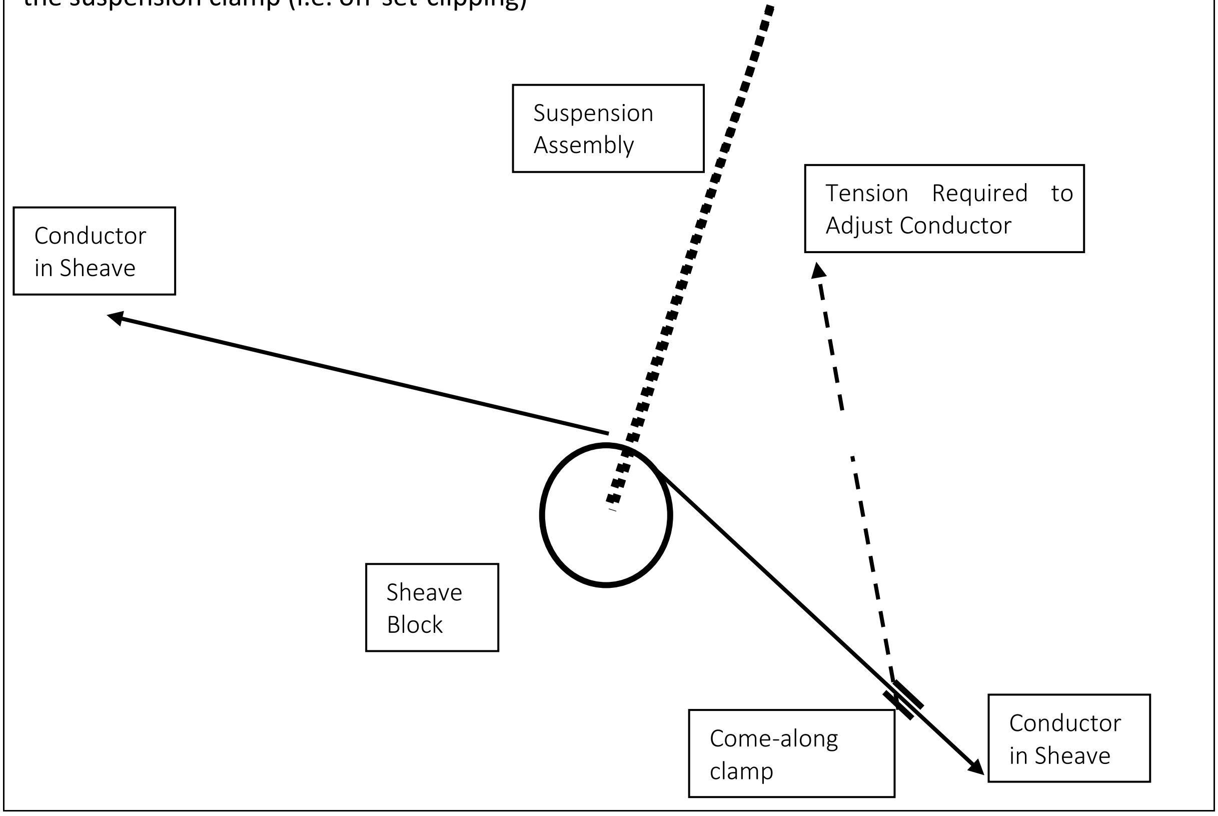
The above co-ordination has been broadly incorporated in the **Standard** in the form of load factors and specific component requirements, Tables 18 to 20 in IEC 60826, should be consulted should further specific information and draft be required on supports, foundations or conductors.

Appendix 2 Construction/maintenance examples

The following are typical examples of the general construction/maintenance type loading analysis scenarios which might be required with any project:

A2.1 Suspension Structures

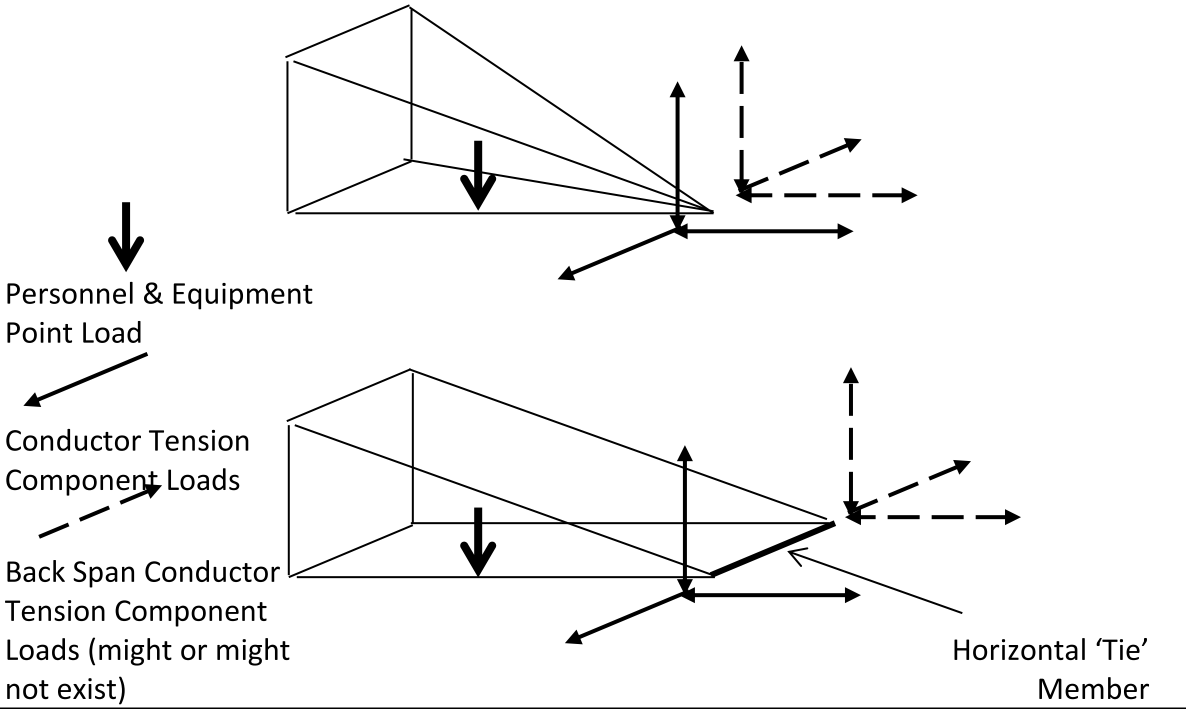
At any suspension attachment points, the load to adjust conductor into the correct position for the suspension clamp (i.e. off-set-clipping)



In the above rigging arrangement, there is the possibility that the square-rigging of the crossarm will be required, due any cross arm vertical capacity limitations.

A2.2 Strain Structures

At any tension attachment point, the possible conductor construction loading scenarios require to be assessed.

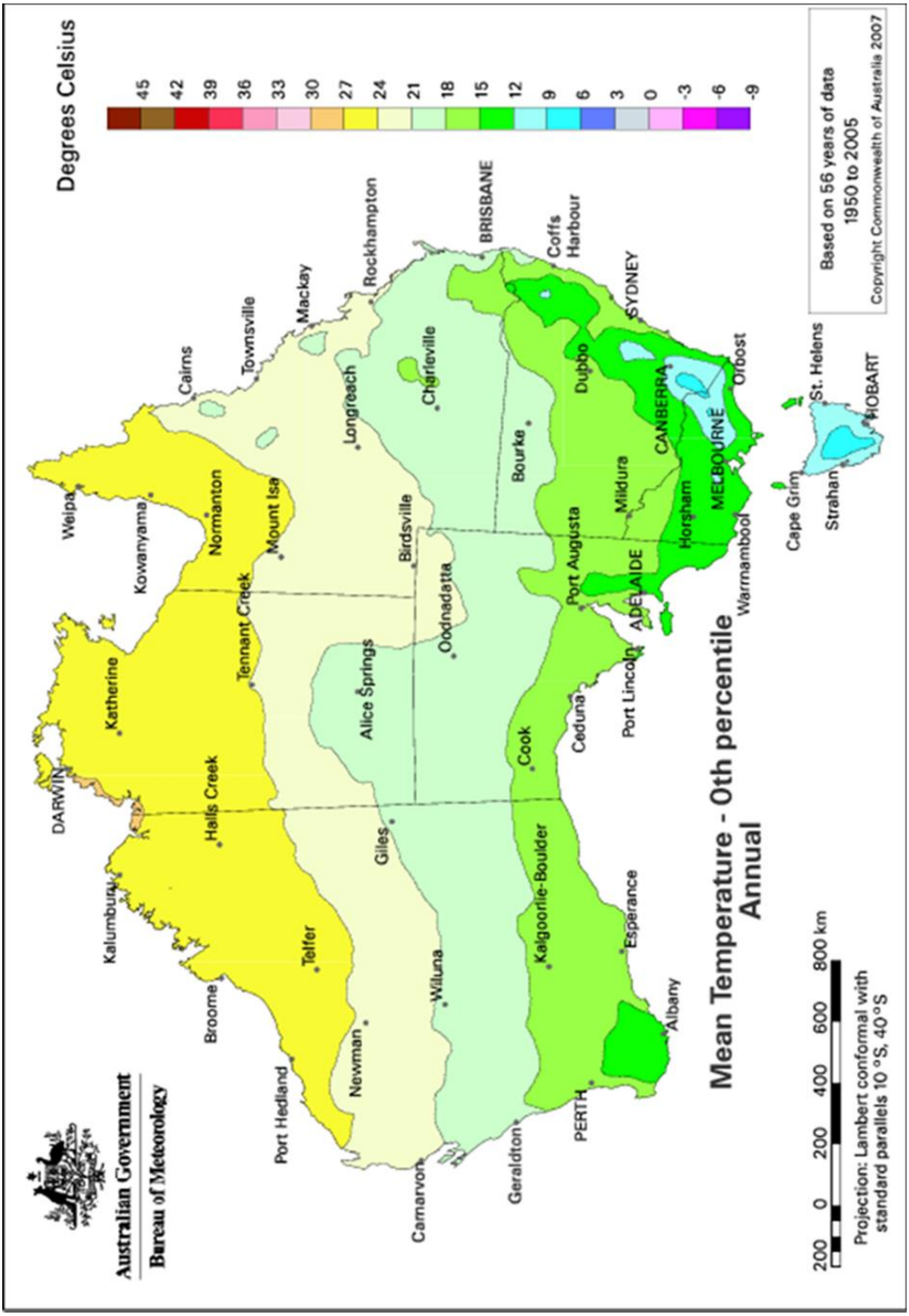


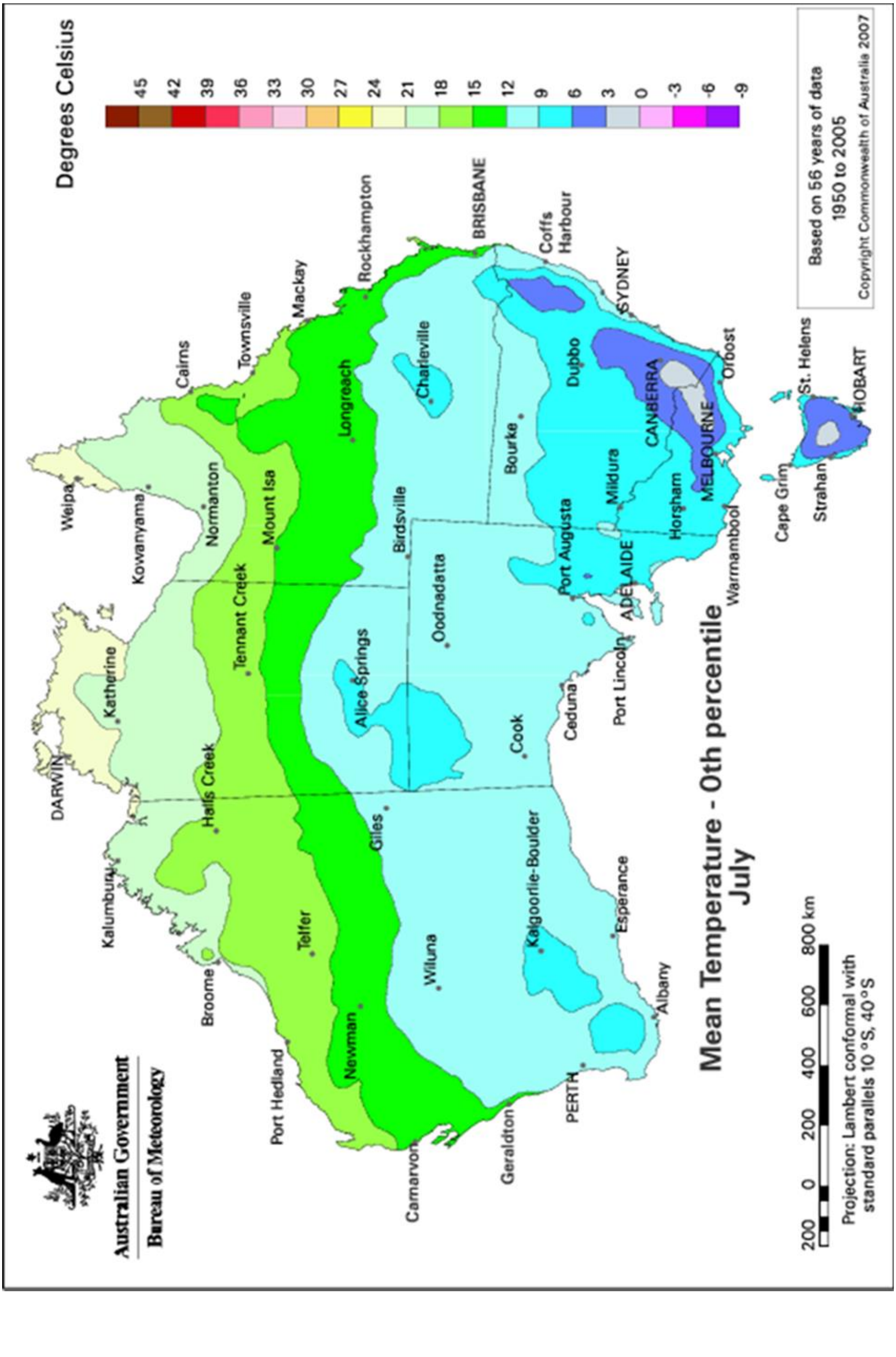
Either dynamic or static load factors are to be applied. Back-span tension components (indicated with dotted arrows) might or might not exist, depending on work phase, maintenance or upgrade being undertaken.

The possibility of more than a single personnel/equipment point load shall be considered. With the back span strung, the horizontal-tie member for square type cross arms should be checked for the tension load and a point load bending moment effect from 'personnel'.

Where short spans are being worked on, the potentially very large temporary additional tension component values must be considered in the construction/maintenance operations. The 'shortening' of a short span during a 'making-off' operation of the span ends potentially results in very large unexpected temporary tension values if not examined and controlled.

Appendix 3 Climate data




Degrees Celsius
45
42
39
36
33
30
27
24
21
18
15
12
9
6
3
0
-3
-6
-9
Australian Government
Bureau of Meteorology
Mean Temperature - 0th percentile
July
Based on 56 years of data
1950 to 2005
Copyright Commonwealth of Australia 2007
200 0 200 400 600 800 km
Projection: Lambert conformal with
standard parallels 10°S, 40°S
DARWIN
Katherine
Weipa
Kowanyama
Normanton
Cairns
Townsville
Mackay
Rockhampton
BRISBANE
Coffs Harbour
SYDNEY
CANBERRA
MELBOURNE
HOBART
Orbost
Dubbo
Bourke
Charleville
Longreach
Mount Isa
Tennant Creek
Halls Creek
Kalumburu
Broome
Port Hedland
Telfer
Newman
Carnarvon
Geraldton
PERTH
Wiluna
Giles
Alice Springs
Birdsville
Oodnadatta
Kalgoorlie-Boulder
Esperance
Albany
Cook
Ceduna
Port Lincoln
Port Augusta
ADELAIDE
Mildura
Horsham
Warrnambool
Cape Grim
Strahan
St. Helens

Appendix 4 Technical data sheet and requirements

Data to be supplied to TasNetworks

Item		Project Specific Requirements
a	Nominal system voltage phase to phase	
b	Lightning/switching impulse withstand voltage	
c	Circuits; double or single	
d	Phase conductor configuration and any additional requirements (e.g. ice x-arms or specific phase clearances)	
e f g	Number & type of conductors per phase - rating and/or power transfer required - maximum operation temp. of conductors	
H i	Number and type of earthwires or communications wires Additional Requirements (e.g. relative sag to conductor, shielding angle)	
j	The transmission line security level	
k	Design working life	
l	Steel yield strength (grade)	
m	Bolt strength	
n	Regulatory Loads or requirements if they exist	
o	Pollution/Contamination level for the line	
p	Minimum applicable temperature	
q	Frequency of cascade failure “stop” structures	
r	Specific TL Easement constraints (e.g. blowout restrictions)	
s	TL Locality	
t	Survey Status	

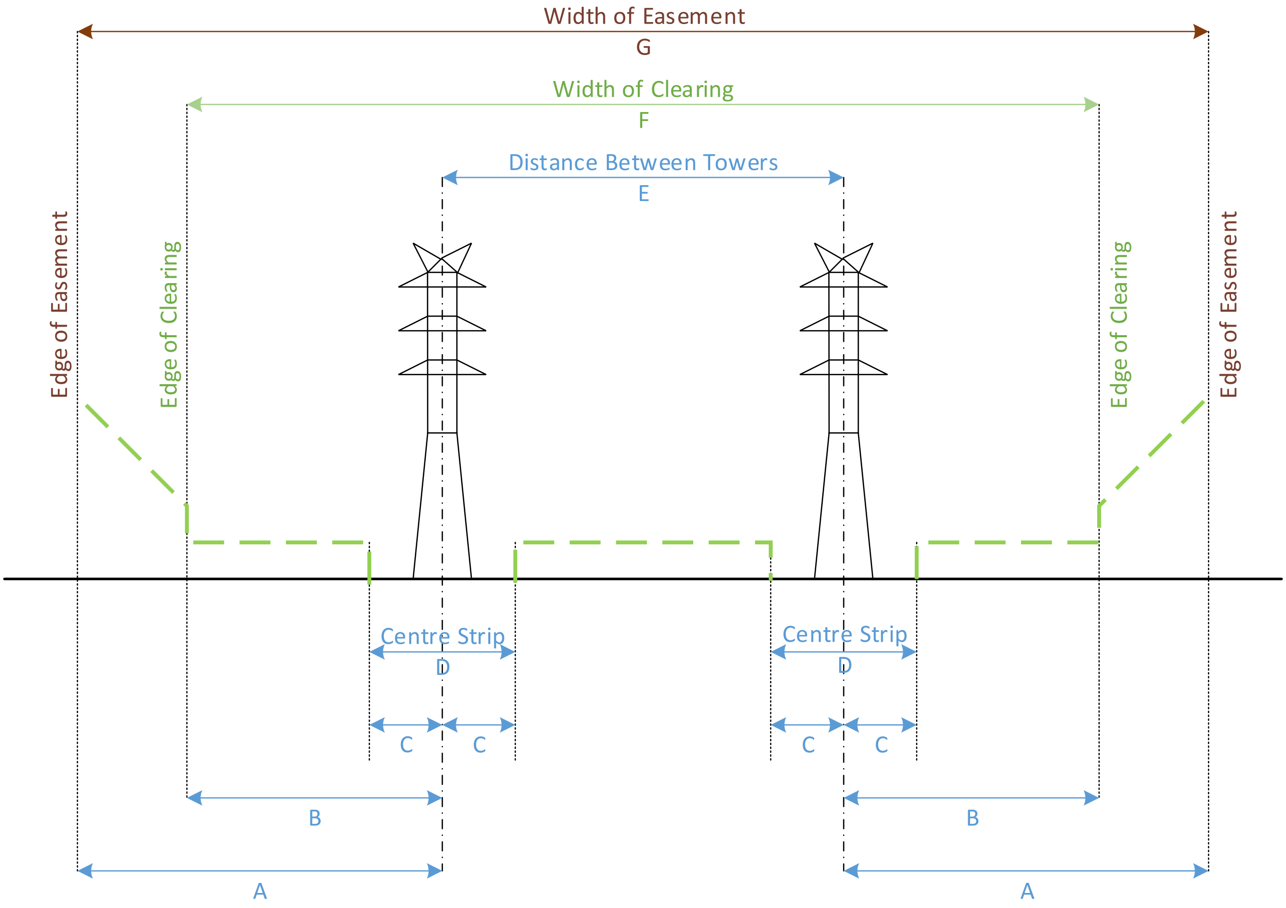
Item		Project Specific Requirements
u	Landowner/property access requirements, requests and conditions	
v	List of existing asset documents provided	
w	Tower drawings provided	
x	Particular unique aspects or features. (e.g. deviations)	

Phase & Earth wire Details

		Phase Conductor	Earthwire
a	Material		
b	Stranding		
c	Standard Name		
d	Diameter (mm)		
e	Cross Sectional Area (mm^2)		
f	Ultimate Strength (kN)		
g	Final Young's Modulus (GPa)		
h	Coefficient Expansion (/°C)		
i	Long Term Creep Correction		
j	Short Term Creep Correction		

Appendix 5 TasNetworks Standard Easement Widths

Figure 2 TasNetworks Easement Widths



all dimensions in metres

LINE VOLTAGE	A	B	C	D	E	F	G
110 kV single circuit	25	20	6	12	-	40	50
110 kV double circuit	25	18	5	10	-	36	50
220 kV single circuit	30	23	9	18	-	46	60
220 kV double circuit	30	20	6	12	-	40	60
110 kV single + 110 kV single circuit	25	20	6	12	20	60	70
110 kV single + 110 kV double circuit	25	20 18	6 5	12 10	20	58	70
110 kV double + 110 kV double circuit	25	18	5	10	20	58	70
110 kV single + 220 kV single circuit	25 30	20 23	6 9	12 18	30	73	85

LINE VOLTAGE	A	B	C	D	E	F	G
110 kV single + 220 kV double circuit	25 30	20	6	12	30	70	85
110 kV double + 220 kV single circuit	25 30	18 23	5 9	10 18	30	71	85
110 kV double + 220 kV double circuit	25 30	18 20	5 6	10 12	30	68	85
220 kV single + 220 kV single circuit	30	23	9	18	30	76	90
220 kV single + 220 kV double circuit	30	23 20	9 6	18 12	30	73	90
220 kV double + 220 kV double circuit	30	20	6	12	30	70	90
275 kV double or single circuit	35	25	10	20	-	50	70
330 kV double or single circuit	35	25	10	20	-	50	70
275 kV double circuit + 275 kV double circuit	35	25	10	20	30	80	100
330 kV double circuit + 330 kV double circuit	35	25	10	20	30	80	100

HVDC Circuits

LINE VOLTAGE	A	B	C	D	E	F	G
HVDC up to 500 kV double or single circuit	35	25	10	20	-	50	70

No assessment has been done on the easement widths required when an HVDC line and an AC line share the same easement. Reference will need to be made to the work of EPRI in establishing the separation needed to avoid magnetic and capacitive effects between the AC and DC circuits.