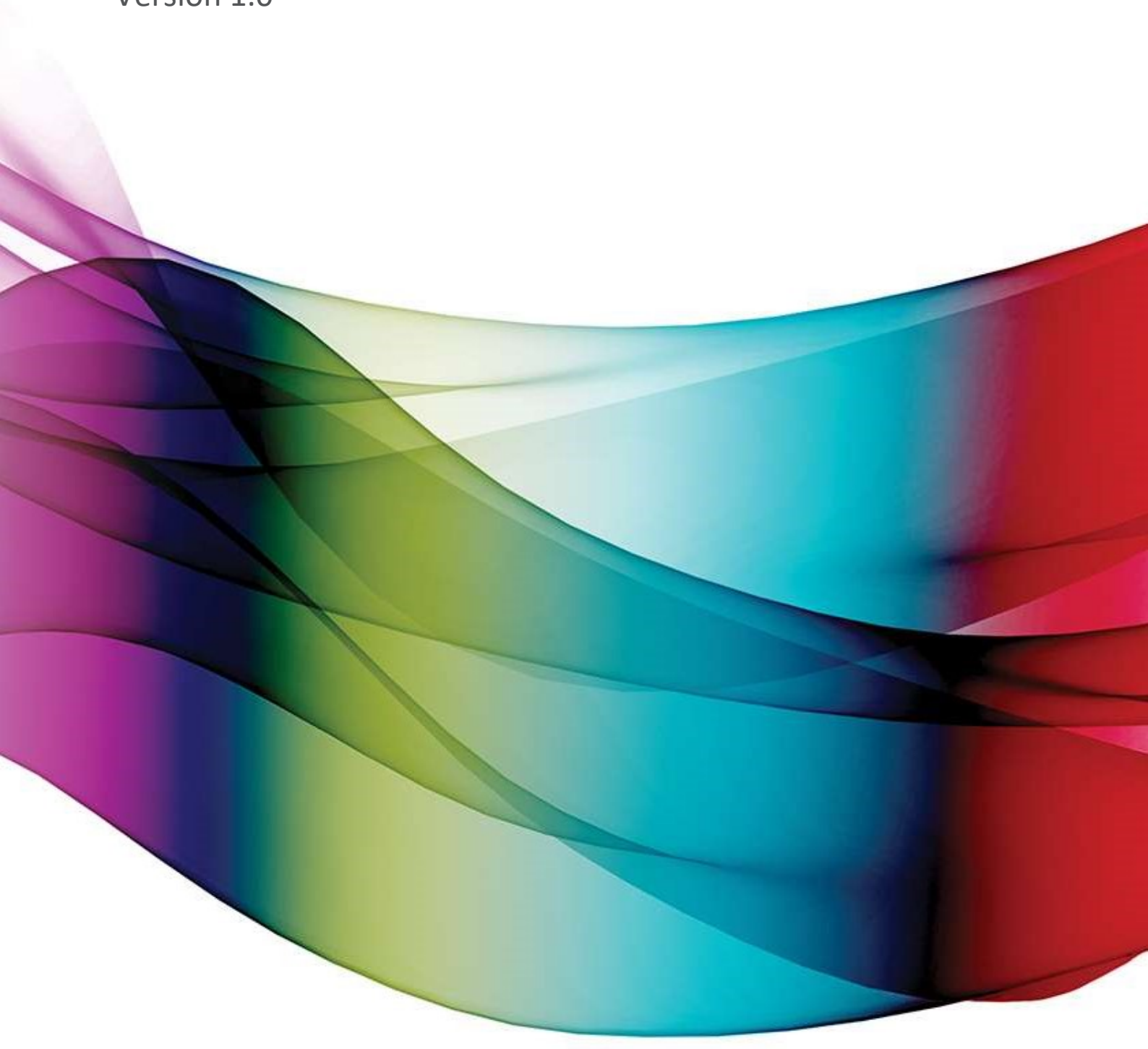
Load Performance Standard (George Town)

May 2021

Version 1.0



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Revisions

Version	Date	Comment
1.0	May 2021	Original issue
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1 Introduction

This *performance standard* defines the technical requirements for *connection applicants* proposing to connect additional *load* to TasNetworks' George Town 220/110 kV Substation (**GT**) with a maximum demand in excess of 50 MW. The requirements in this *performance standard* define and extend the conditions specified in Schedule 5.3 of the *National Electricity Rules* ***(Rules)*** [1]***.***

2 Information requirements

2.1 Information from *Network User*

***Rules* clause S5.3.1(a) and S5.3.1(a1)**

Network User must submit information to TasNetworks as specified in clause **S5.3.1(a)** and **S5.3.1(a1)** of the ***Rules***.

It is the responsibility of the intending *connection applicant* to understand the modelling requirements specified by the ***Rules*** and provide analytical models that satisfy the requirements of AEMO's *Power System Model Guidelines* **S5.3.1(a2)**. Refer to Section 11.7 for more details.

TasNetworks requires that the analytical models provided as per **S5.3.1(a1)** accurately represent the *Network User's plant* and its *control* and *protection systems*. The modelling requirements at GT are necessarily extensive for *Network Users* wishing to connect additional power electronic based *load* because of the need to reliably integrate with existing *Network Users,* noting that:

1. GT connects to the Victorian network via a large thyristor controlled HVDC interconnector;
2. GT already supplies very high levels of power electronic based *load*; and
3. Additional *load* at GT shall be "responsive" to facilitate *connection*.

2.2 Information from TasNetworks

***Rules* clause S5.3.1(b)**

TasNetworks will provide, if requested, the information specified in clause S5.3.1(b) of the ***Rules***.

2.2.1 Fault currents and source impedance information

***Rules* clause S5.3.1(b)(1) & (4)**

TasNetworks publishes its analysis of existing maximum and minimum fault levels and source impedances at all *connection points* within its network as part of its Annual Planning Report (APR) on its website[1].

[1] https://www.tasnetworks.com.au/Poles-and-wires/Planning-and-developments/Planning-our-network

3 Design standards

***Rules* clause S5.3.2 & S5.3.9**

The *Network User* must ensure that its electrical *plant* installed within the *connection site* or connected to GT complies with the relevant *Australian Standards* as applicable at the time of first installation of that electrical *plant* in the *facility.*

The design or modification of *plant* must be capable of withstanding the maximum design fault level unless otherwise agreed in writing with TasNetworks.

Network User must comply with the requirements of clause **S5.3.9** of the ***Rules*** unless specifically modified by agreement with TasNetworks.

3.1 Maximum design voltages and impulse levels

Network User must ensure that any new equipment, including circuit breakers, are capable of withstanding, without damage, the power frequency voltages and impulse levels determined in accordance with clause **S5.1a.4** of the ***Rules***.

If a *Network User* has a *connection point* that electrically forms part of the Tasmanian *distribution network*, the *Network User* must consider the permissible voltage variations[2] as per the Tasmanian Electricity Code [2] when designing its *plant*.

3.2 Surge Protection

Network User must ensure that appropriate surge protection has been considered and implemented for the *connection site*.

3.3 Maximum design fault levels

***Rules* clause S5.3.1(b)(1)**

TasNetworks requires that the three phase and single phase fault current ratings of the *Network User's* circuit breakers at the *connection point* are not less than 25 kA; to allow for future increases in network fault levels.

3.4 Fault current in-feed to the network

Network User must agree with TasNetworks on the maximum fault current in-feed from its plant to the network during network fault conditions.

[2] Chapter 8, Table 2 [2].

4 Protection system and settings

***Rules* clause S5.3.3 and clause S5.3.1(b)(2)**

4.1 Fault clearance times

The *Network User* must ensure that its protection systems comply with the fault clearance time requirements specified in Table S5.1a.2 of the ***Rules***.

TasNetworks and *Network User* are each responsible for ensuring the compliance of their own equipment with the specified maximum fault clearance times. TasNetworks will provide the *Network User* with detailed protection system requirements as part of the *connection application* process as required.

4.2 Protection of Network User's plant

Network User is responsible for ensuring that appropriate protection systems are designed and implemented within its *facility to* prevent damage to its *plant* and/or equipment from disturbances emanating from the network.

5 Settings of protection and control systems

***Rules* clause S5.3.4**

Network User must only apply settings to a *control system* or a *protection system* that have been approved by TasNetworks.

Network User must ensure that all *control system* settings and *protection settings* comply with relevant performance standards and do not cause the *inter-regional or intra-regional power transfer capability* to be reduced.

6 Power factor requirements

***Rules* clause S5.3.5**

TasNetworks requires *Network User* to meet the *automatic access standard* (0.95 lagging power factor) for the maximum reactive power absorption of the *load*. *Network User* shall agree upon a *minimum access standard* with TasNetworks to enable the *load* to operate with a leading power factor range in response to a low grid voltage, i.e. to supply reactive power to the network. The power factor shall be measured at the *connection point* as specified in clause **S5.3.5** of the ***Rules***.

7 Balancing of load currents

***Rules* clause S5.3.6 and clause S5.3.1(b)(3)**

Network User must meet the *automatic access standard* for load current balancing at the *connection point*.

TasNetworks will allocate a proportion of the allowed maximum negative sequence voltage at GT to the *Network User* to use as its voltage unbalance emission limits at the *connection point* of its

plant. *Network User* must ensure that the voltage unbalance arising from the energisation, de-energisation or other plant operations does not exceed its allocated voltage unbalance emission limits.

8 Voltage fluctuations

***Rules* clause S5.3.7 and clause S5.3.1(b)(3)**

Network User must meet the *automatic access standard* specified in clause **S5.3.7** of the ***Rules*** at the *connection point*.

8.1 Emission limits for voltage fluctuations

In accordance with the procedures outlined in Section 8 of AS/NZS 61000.3.7:2001, TasNetworks will allocate a proportion of the allowed voltage fluctuation limits to the *Network User* to use as its voltage fluctuation emission limits at the *connection point* of its plant. These limits are also termed "flicker level" limits. *Network User* must ensure that the voltage fluctuations arising from the energisation, de-energisation or other operations do not exceed the allocated voltage fluctuation emission limits.

8.2 Rapid Voltage Changes

Network User must limit any rapid voltage fluctuation (as per AS/NZS 61000-3-7) to less than 2.5% of nominal voltage at the *connection point*, considering operation at minimum fault level.

Where the proposed design of *Network User's* plant does not meet the rapid voltage change criteria, e.g. during energisation, TasNetworks will require the introduction of mitigation measures. *Network User* should consider a broad range of operating conditions when assessing compliance with these criteria, most critically, minimum fault level scenarios with and without local dynamic reactive power sources in service.

9 Harmonics and voltage notching

***Rules* clause S5.3.8 and clause S5.3.1(b)(3)**

Network User must meet the *automatic access standard* specified in clause **S5.3.8** of the ***Rules*** at the *connection point*.

9.1 Emission limits for voltage waveform distortion

In accordance with the procedures outlined in Section 8 of AS/NZS 61000.3.6:2001, TasNetworks will allocate a proportion of its harmonic "planning levels" to *Network User* to use as its emission limits for voltage waveform distortion at the *connection point* of its *plant.* It will be *Network User's* responsibility to assess the compliance of its *plant* with the allocated emission limits. *Network User* must ensure that the harmonic voltage distortion caused by: non-linearity, switching of power electronic equipment, harmonic resonance and other effects within its ***connection site*** does not exceed the allocated limits. If requested, TasNetworks will provide harmonic impedance "polygons"

of its network to assist with this assessment. TasNetworks will undertake its own due diligence studies of the *plant's* harmonic performance, refer to Section 11.7.

10 Under frequency load shedding (UFLS)

***Rules* clause S5.3.10**

Clause **4.3.5** of the ***Rules*** mandates *Network User* to provide a minimum of 60% of its expected demand as *interruptible load* for automatic disconnection in case of *non-credible* power system under-frequency events. AEMO and TasNetworks will determine the appropriate UFLS settings for the *Network User's* load blocks.

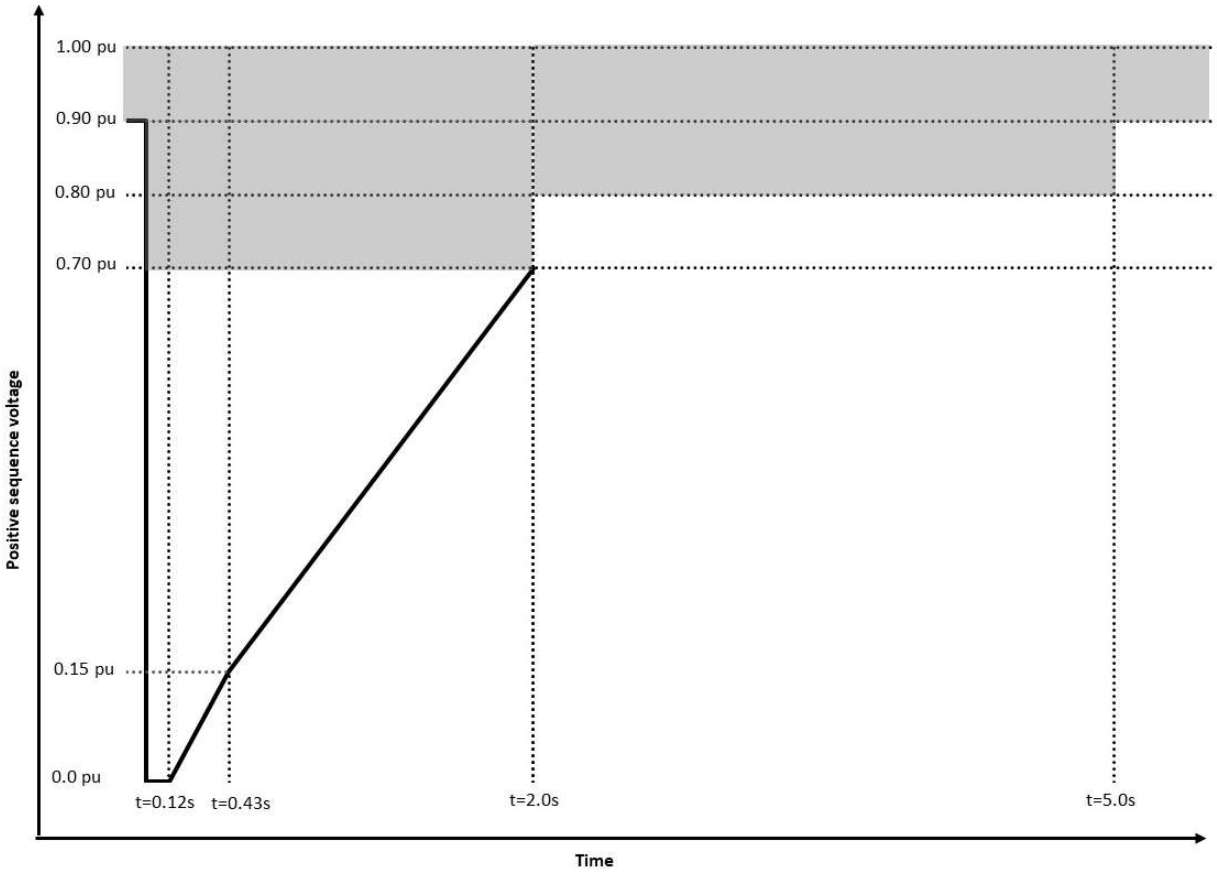
11 Other Technical Requirements and Considerations

***Rules* clause S5.3.1(b)(5)**

11.1 Response to Network Faults

Network User load and *plant*, including any in-service reactive *plant*, must operate continuously and without interruption for power system disturbances that describe a voltage/time within the fault recovery profile as shown in Figure 1; where the voltage at the *connection point* may vary anywhere above the heavy black line or within the grey shaded areas.

Figure 1: Voltage against time profile for under voltage events



It should be noted that:

(a) The heavy black line presented in Figure 1 represents the lower limit of the voltage/time profile at the *connection point* before, during and after a fault. The grey shaded area in Figure 1 represents the *minimum access standard* of **S5.2.5.4**.

(b) The *minimum access standard of **S5.2.5.4*** targets the performance of *generating systems.* However, it is TasNetworks requirement that *load* customers above 50 MW also meet this minimum capability and aim for a capability as close as possible to the *automatic access standard* of **S5.2.5.4**.

(c) Voltage is defined as the residual positive phase sequence voltage at the *connection point* resulting from a fault occurring on or between any combination of the three phases and ground.

(d) *Network User* is expected to provide under and over voltage protection settings for assessment as part of the information specified in clause **S5.3.1(a1).**

11.2 Response to Frequency Events

Network User load and *plant*, including any in-service reactive *plant*, must operate continuously and without interruption for system frequencies and corresponding time frames as specified in the Tasmania region of the Frequency Operating Standard [3]. If *Network User* wishes to offer Frequency Control Ancillary Services to the National Electricity Market, *Network User* must engage with AEMO. However, TasNetworks can assist in the implementation of equipment needed to offer these services.

11.3 Largest Single Contingency Size

Network User will need to consider the largest single contingent loss of load as a part of their overall *plant* design. Noting that the availability of "lower" Frequency Control Ancillary Services in Tasmania is limited. Currently, the largest single contingent loss of *load* is approximately 120 MW.

TasNetworks can provide further information on these specific requirements during the *connection application* process.

11.4 Participation in Runback and System Protection Schemes

To facilitate the connection of additional substantial load at GT, *Network User* will be required to participate in a centralised System Protection Scheme operated by TasNetworks. TasNetworks will provide *Network User* with the necessary trip and/or runback control signals for this scheme. Although the scheme will operate very rarely, its end to end functionality must be highly reliable: therefore *Network User* will be required to install appropriate communication systems with diverse communication paths (See Section 11.5).

11.5 Communication Requirements

Fully duplicated communication facilities must exist between the *Network User's* substation and the connection site. Route diversity is also a requirement: using separate fibres in a single optical fibre ground wire is not acceptable for the purposes of duplicating trip and/or runback control signals.

11.6 Reactive Power Support

The *connection* of additional substantial *load* at GT will require TasNetworks to augment GT with fast voltage support in the form of dynamic reactive power injection from STATCOM devices etc. The size and cost of these supporting devices will somewhat depend upon the dynamic characteristics of the additional *load*. For instance a *load* that is capable of supplying some fast reactive power compensation will reduce the augmentation (and cost) requirements placed on TasNetworks. TasNetworks will determine the actual augmentation requirements after receipt of the *connection application.*

11.7 Provision of Analytical Models

Although not a general requirement for *load* customers, TasNetworks requires that *Network Users* proposing the *connection* of additional substantial *load* at GT provide appropriate analytical *plant* models (**S5.3.1(a1)**) as part of the *connection application*. The *connection applicant* will be expected to undertake the appropriate *connection* studies demonstrating the *plant's* compliance with *performance standards* and **Rules** requirements.

These models are needed to confirm that *Network User's plant:* integrates reliably with the *plant* of existing *Network Users* at GT*,* can meet its performance requirements when integrated and does not degrade the performance of other *Network Users.* Noting that:

1. GT connects to the Victorian network via a large thyristor controlled HVDC interconnector;
2. GT already supplies very high levels of power electronic based load; and
3. The additional load has "responsive" capabilities for *connection* to GT.

Connection applicants will rigorously test and validate its *plant models,* provided under **S5.3.1(a1),** to comply with AEMO's *power system model guidelines* (**S5.3.1(a2)**); similar to the process for *generating systems.* Once validated, the analytical models will be provided to TasNetworks and AEMO for their due diligence assessment of the *connection application.*

Connection applicants shall provide AEMO and TasNetworks with:

- a PSS/e™ model of its *plant* for wide area network studies; and
- a PSCAD™ model of its *plant* for GT integration studies.

Connection applicants may also choose to provide TasNetworks with a Digsilent (Power Factory™) model of its plant for TasNetworks' assessment of the *connection applicant's* harmonic performance report. TasNetworks may accept alternative means of harmonic data provision on request.

11.8 Additional Technical Requirements

Network User must limit normal *load* switching events within its *plant* to less than 30 MW per five minute market dispatch interval. TasNetworks may agree to higher levels for a *load* restoration process subject to the capability limits as determined by TasNetworks' real time operational control centre.

TasNetworks may provide additional or further technical advice to the *Network User* upon receipt of all the information as specified in schedules **S5.3.1(a)** and **S5.3.1(a1)** of the *Rules*.

12 High Speed and Power Quality Monitoring

TasNetworks requires the installation of its standard High Speed Monitoring and Power Quality Monitoring equipment at the *connection point.* Specific configurations for these equipment at the *connection* will be determined during detailed design.

13 References

[1] National Electricity Rules, Version 164, 13 May 2021.

[2] Tasmanian Electricity Code, Chapter 8, Distribution System Operation.

[3] Frequency Operating Standard, AEMC Reliability Panel, 1 January 2020.