ElectraNet

Connection Principles and Typical Substation Configurations

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Contents

1. Definitions

In this document the following words and expressions will have the following meanings:

Item	Meaning
DCA	Dedicated Connection Assets
ESCOSA	Essential Services Commission of South Australia
Generator/Load System	Any system that includes the infrastructure of a *generator* or load user
IUSA	Identified User Shared Assets
MTBF	Mean Time between Failure
MTTR	Mean Time to Repair
NER	National Electricity Rules
OTR	Office of the Technical Regulator, Government of South Australia
Rules	The National Electricity Rules made under Part 7 of the *National Electricity Law* which is set out in the schedule to the *National Electricity (South Australia) Act 1996* (SA)
SPAR	Single Pole Auto – Reclose
TPR	Three Pole Reclosing

2. Purpose

The purpose of this document is to provide principles adopted by ElectraNet in developing typical connection configurations, in order to provide *Connection Applicants* with an overview of ElectraNet's standard design requirements for the *connection* of new Generator/Load Systems to its *transmission network*.

In particular, it summarises the main principles which ElectraNet will apply in:

a) designing the configuration of the *connection* arrangements for new generator or load customers seeking *connection* to ElectraNet's *transmission network*;

b) classifying assets which are built under those *connection* arrangements as prescribed assets, Identified User Shared Assets (IUSA) and Dedicated Connection Assets (DCA); and

c) defining the boundary between prescribed assets, IUSA and DCA.

Information provided in this document is for general information purposes only.

In particular, whilst it has been designed to provide *Connection Applicants* with some guidance concerning the manner in which ElectraNet *connects* new Generator/Load Systems to its *transmission network*, it is subject in all respects to the requirements of the Rules and the South Australian *applicable regulatory instruments*.

Each *Connection Applicant* should seek its own advice concerning the application of the Rules and the South Australian *applicable regulatory instruments* to the connection of its new Generator/Load System to ElectraNet's *transmission network*.

In this document, unless the context otherwise requires:

a) words defined in the Definitions will have the meaning assigned to those words;

b) words appearing in italics will have the meaning assigned to them from time to time by the Rules; and

c) a reference to a Chapter, rule, clause, paragraph or schedule of the Rules or an *applicable regulatory instrument* as being relevant to a principle or matter outlined in this document is not intended to suggest that is the only Chapter, rule, clause, paragraph or schedule of the Rules or the *applicable regulatory instruments* which may be relevant to that principle or matter.

3. Scope

The Rules do not seek to specify all of the technical requirements which should be applied when designing the configuration of the *connection* arrangements for a new Generator/Load System.

Whilst some general technical requirements for the establishment of new Generator/Load System *connections* are set out in the Rules, most technical matters relating to the design and configuration of the *connection* arrangements for new Generator/Load Systems are not specifically dealt with in the Rules and are left to *Transmission Network Service Providers* to address by applying the dual goals of:

a) ensuring consistency with *good electricity industry practice*; and

b) maintaining the safe and reliable operation of the *power system* in accordance with the Rules.

ElectraNet is required under the Rules to ensure that any 'offer to connect' a new Generator/Load System to its *transmission network* is fair and reasonable and is consistent with the safe and *reliable* operation of the *power system* in accordance with the Rules (see clause 5.3.6(c) of the Rules).

ElectraNet is also required to adopt consistent processes for determining the appropriate technical requirements which should apply to each *connection* enquiry or *application to connect* processed by ElectraNet under clause 5.3 of the Rules (see clause S5.1.1 of the Rules).

This document has been prepared to assist intending *Connection Applicants* in understanding these requirements and processes.

This document also aims to:

a) ensure that all applications to connect new Generator/Load Systems to the ElectraNet *transmission network* are treated equitably and consistently;

b) provide a framework that allows *applications to connect* new Generator/Load Systems to ElectraNet's *transmission network* to be dealt with efficiently;

c) identify high-level general principles which ElectraNet will apply when designing the configuration of the *connection* arrangements for new Generator/Load Systems; and

d) identify a number of standard *connection* configurations for new Generator/Load Systems.

Sections 5 to 11 set out the high level general principles, which ElectraNet will apply when designing the configuration of the *connection* arrangement for a new Generator/Load System.

Section 12 sets out some examples of typical designs for the configuration of the *connection* arrangement for a new Generator/Load System which would result from the application of these high level general principles.

4. General Connection Principles – Rules Overview

Chapter 5 of the Rules:

a) records the general principles, guidelines and processes governing *connection* and access to *transmission networks*; and

b) establishes the framework for *connection* to *transmission networks* and access to the *network services* provided by *transmission networks*.

Chapter 5 of the Rules is based on various high level principles relating to connection to the national grid.

The most relevant high level principle for the purpose of this Document is set out in clause 5.1A2(c)[1] which states that:

> '…the technical terms and conditions of *connection agreements* regarding standards of performance must be established at levels at or above the *minimum access standards* set out in schedules 5.1, 5.2, 5.3 and 5.3a, with the objective of ensuring that the *power system* operates securely and reliably and in accordance with the *system standards* set out in schedule 5.1a'.

Clauses 5.2.2(d) and 5.2.3(b) of the Rules support this high level principle by:

a) requiring that the terms upon which a new Generator/Load System is *connected* to the *transmission network* must not adversely affect the quality or security of the *network services* being provided to other N*etwork Users* (i.e. both current *Network Users* and future *Network Users*); and

b) providing that this requirement will prevail over any term of the *connection agreement* for a new Generator/Load System which is inconsistent with this requirement.

ElectraNet is also required by clause 5.2.3(e1) of the Rules to arrange for:

a) the management, maintenance and operation of its *transmission system* such that in the *satisfactory operating state*, electricity may be transferred continuously at a *connection point* on or with its *transmission network* up to the *agreed capability* for that *connection point*;

b) the management, maintenance and operation of its *transmission system* to minimise the number of interruptions to *agreed capability* at a *connection point* on or with its *transmission network* by using *good electricity industry practice*; and

c) restoration of the *agreed capability* at a *connection point* on or with its *transmission network* as soon as reasonably practicable following any interruption at that *connection point*.

Finally, ElectraNet is required under clause 5.3.6(c) of the Rules to ensure that any 'offer to *connect*' a new Generator/Load System to its *transmission network* is fair and reasonable and is consistent with the safe and *reliable* operation of the *power system* in accordance with the Rules.

[1] Prior to 1 July 2018, in clause 5.1.3(c).

There are a number of common themes running through these Rule requirements which have influenced the development of the 'General Connection Principles' set out in sections 5 to 11 of these Guidelines. They are:

a) ensuring that the *connection* arrangements for new Generator/Load Systems do not adversely affect the quality or security of the *network services* being provided to other *Network Users* (i.e. both current *Network Users* and future *Network Users*);

b) ensuring that the *connection* arrangements for new Generator/Load Systems do not impact on the secure, safe and *reliable* operation of the *power system*;

c) ensuring that the *connection* arrangements for new Generator/Load Systems assist in minimising the number and duration of interruptions to *agreed capability*; and

d) achieving these objectives in a fair and reasonable manner which is consistent with *good electricity industry practice*.

5. Connection Principle No. 1

5.1 Statement of principle

The configuration of the *connection* arrangement for a proposed new Generator/Load System must:

a) not adversely affect *power system security*;

b) not adversely affect the quality of *network services* to other *Network Users*;

c) not hinder access by other *Network Users (*both current and future) to the *prescribed transmission services* or *identified user shared assets* provided by ElectraNet using its *transmission system*; and

d) be otherwise consistent with *good electricity industry practice*.

5.2 Source of principle

a) General Connection Principle No. 1 reflects the overriding requirements of clauses 5.2.2(d), 5.2.3(b), 5.3.6(d) and 6A.1.3(3) of the Rules and Schedules S5.1, S5.1a and S5.2 of the Rules.

b) This Connection Principle forms the underlying basis for all of the other Connection Principles.

5.3 Specific design requirements which result from applying this principle

a) The occurrence of a *credible contingency event* in relation to a Generator/Load System should not result in:

   (i) *disconnection* of any other *Network User's facility*;

   (ii) any interruption to the provision of *transmission services* to other *Network Users*;

   (iii) any reduction in the *power transfer capability* of the *transmission network*; or

   (iv) any reduction in the *power transfer* between *transmission systems*.

b) In particular, the failure of a protection device or circuit breaker (which forms part of a Generator/Load System) to operate correctly when required and the subsequent operation of the related breaker-fail protection should not result in:

   (i) an adverse effect on *power system security*;

   (ii) the *disconnection* of any other *Network User's facility*;

   (iii) any interruption to the provision of *transmission services* to other *Network Users*;

   (iv) any reduction in the *power transfer capability* of the *transmission network*; or

(v) any reduction in the *power transfer* between *transmission systems*.

c) As a consequence the configuration of all new connections to the 275 kV *transmission network* or to the meshed (i.e. non-radial) 132 kV *transmission network* for a new Generator/Load System must be designed with at least a three circuit breaker mesh or ring arrangement and be capable of meeting and be able to be ultimately configured to meet the OTR[2] requirement of a breaker and a half configuration.

d) IUSA must be available for greater than 99.98% considering both MTBF and MTTR.

[2] http://www.sa.gov.au/topics/energy-and-environment/electrical-gas-and-plumbing-safety-and-technical-regulation/compliance-and-enforcement/generation-applications

6. Connection Principle No. 2

6.1 Statement of principle

The configuration of the *connection* arrangement for a new *generator system* must be designed so that no more than the co-optimised maximum dispatch from a *Generator* will be *disconnected* from the *power system* following the occurrence of a *single credible contingency event*.

6.2 Source of principle

a) General Connection Principle No. 2 reflects:

(i) the *power system security* parameters applied by *AEMO* for the purpose of Chapter 4 of the *Rules* (and, in particular, the requirements of clauses 4.2 and 4.3 of the *Rules*);

(ii) the general requirements of Schedule 5.1 of the *Rules*; and

(iii) the requirements of Connection Principle No. 1.

b) AEMO is responsible under the *Rules* for determining and revising the *technical envelope* for the *power system* (i.e. the technical boundary limits of the *power system* for achieving and maintaining the *secure operating state* of the *power system* for a given demand and *power system* scenario).

c) *AEMO* must undertake this process in accordance with the requirements of clause 4.2.5(b) of the *Rules* by taking into account the prevailing *power system* and *plant* conditions from time to time as described in clause 4.2.5(c) of the *Rules*.

d) As part of dispatch process, *AEMO* will determine the co-optimised maximum generation dispatch for the South Australian region, which is a dynamic optimisation of interconnector flow and the maximum dispatch from any *Generator'*(s) *facility* that can be lost due to a single *credible contingency event*, to keep the *power system* in a *secure operating state*.

6.3 Specific design requirements which result from applying this principle

a) The configuration of the *connection* arrangement for a new *generating system* must be designed in such a way that the maximum possible co-optimised dispatch and system loading will not be exceeded either within the *Network User's facility*, or within the *transmission system*.

b) Set out below is a range of new *generation system connection* configuration design options which would satisfy this principle:

Connection Configuration	Number of *connection points*	Meshed *Network* or Radial
1	1	Meshed
2	2*	Meshed
3	1	Radial

*where there are a greater number than two *connections* other configurations will be required.

6.4 Connection Configurations

a) Connection Configuration 1

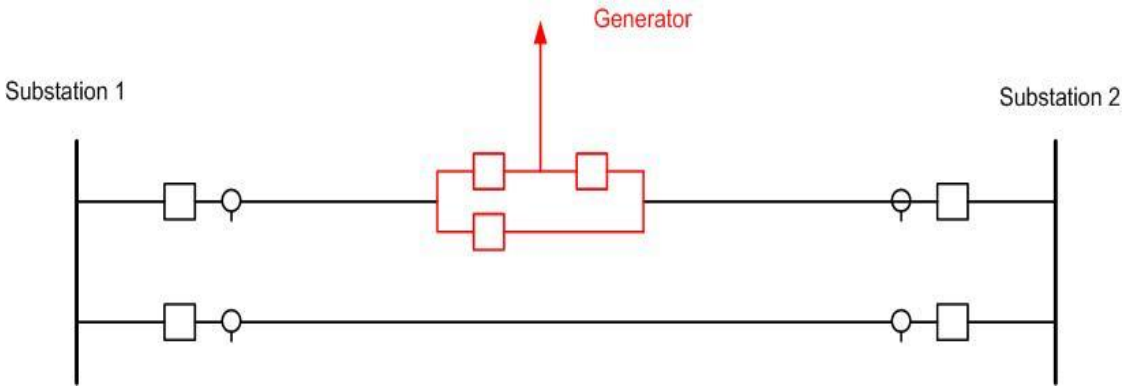

Figure 6-1: Single Connection in meshed network

b) Connection Configuration 2

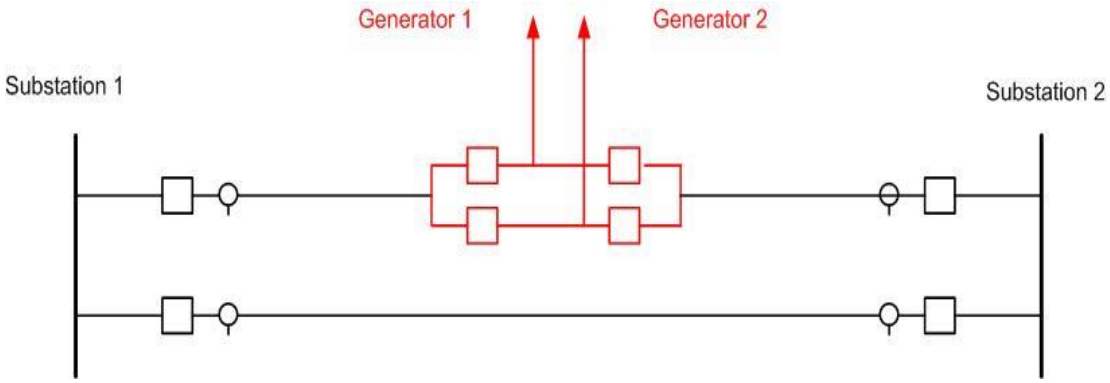

Figure 6-2: Double Connection in meshed network

c) Connection Configuration 3

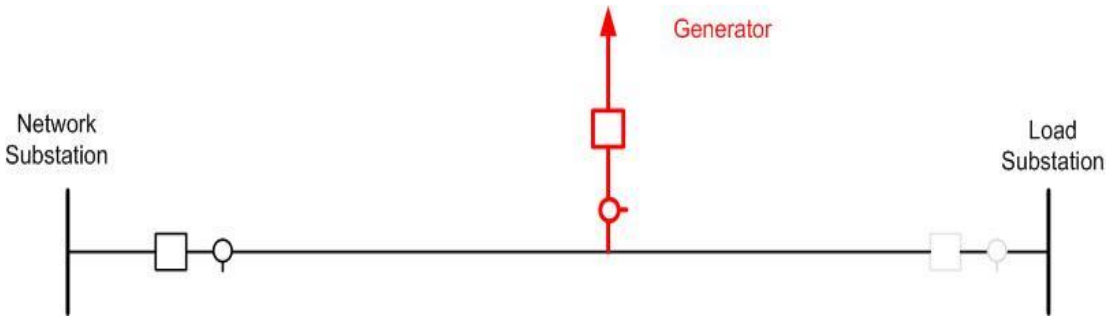

Figure 6-3: Single Connection to a radial line (only one Tee connection allowed)

7. Connection Principle No. 3

7.1 Statement of principle

The configuration of the *connection* arrangement for a new Generator/Load System must be designed in a manner which enables the establishment by ElectraNet of *protection systems* which are compatible with existing ElectraNet systems and:

a) comply with the requirements of Schedules 5.1 and 5.1a of the *Rules*; and

b) can be operated in a manner which is consistent with *good electricity industry practice* both for the relevant *connection* arrangement and the *transmission system* as a whole (i.e. the configuration of the *protection system* arrangement for the *connection* of a new Generator/Load System must provide a level of performance, security and maintainability which is consistent with *good electricity industry practice* and the requirements of Schedules 5.1 and 5.1a of the *Rules*).

7.2 Source of principle

General Connection Principle No. 3 reflects the requirements of:

a) Schedules 5.1 and 5.1a of the *Rules*;

b) *good electricity industry practice*;

c) the South Australian *applicable regulatory instruments* relating to the compatibility of new Generator/Load *S*ystems (and the design of the *connection* arrangements for new Generator/Load *S*ystems) with ElectraNet's *transmission system* so as not to prejudice *power system security* (see section 22(1)(b) of the *Electricity Act 1996* (SA)) ; and

d) the requirements of Connection Principle No. 1.

7.3 Specific design requirements which result from applying this principle

a) ElectraNet requires all *Connection Applicants* to consult with it concerning the design of the *connection* for its *facility* and the equipment selection for all protection functions which are required to coordinate and grade with the *transmission network* in order to:

   (i) minimise interruption or restrictions to *transmission services* due to the operation of those protection functions; and

   (ii) ensure compatibility with the *transmission network*.

b) The method of establishing *protection systems* for new Generator/Load System *connections* which is most consistent with *good electricity industry practice* is via the installation of digital current differential schemes and/or distance protection schemes.

c) The current differential protection *system* is usually established with no more than three line terminals, for reasons of both maintainability and the lack of suppliers of EHV protection equipment which supports more than three differential terminals.

d) Three terminal digital current differential schemes are the standard method of establishing line protection for 275 kV *connections* and represent *good electricity industry practice* for establishing *protection systems* for this type of new Generator/Load System *connection*.

e) The design of any *protection system* which is required to be established as part of the proposed *connection* arrangement for a new Generator/Load System must:

(i) comply with the requirements of Schedules 5.1 and 5.1a of the *Rules*;

(ii) be compatible with existing ElectraNet systems;

(iii) be designed and configured so that it can be operated and maintained in a manner which, complies with the requirements of Schedules 5.1 and 5.1a of the *Rules*, and is consistent with *good electricity industry practice*; and

(iv) otherwise satisfy the requirements of Connection Principle No. 1.

f) Schedule S5.1a.8(f) of the *Rules* specifies the allowable *fault clearance times* for *facilities* constructed or modified on or after 16 November 2003.

g) For *facilities* constructed or modified before 16 November 2003, the allowable *fault clearance times* have been derived by ElectraNet from the existing capability of each *facility* as at 16 November 2003.

h) The configuration and design of the *protection systems* for the proposed *connection* arrangement for a new Generator/Load System must take into account the existing *protection systems* for that portion of the *transmission network* which will or may be impacted by the proposed *connection* of the new Generator/Load System.

i) The *transmission lines* which form part of ElectraNet's *transmission system* are currently fitted with either SPAR or TPR *protection systems*.

j) The configuration and design of the *protection systems* for the proposed *connection* arrangement for a new Generator/Load System must be established in such a way as permits the ongoing use of SPAR or TPR.

8. Connection Principle No. 4

8.1 Statement of principle

The configuration of the *connection* arrangement for a new Generator/Load System (including any *augmentation* or *extension* to the *transmission network* which is required in order to accommodate the *connection* of that new Generator/Load System) must be designed in a manner which:

a) is compatible with the existing *transmission system*;

b) does not hinder the future development of the *transmission system* in accordance with the requirements of Schedule 5.1, the South Australian *applicable regulatory instruments* and *good electricity industry practice*; and

c) does not hinder access by other *Network Users* (both current and future) to the *prescribed transmission services* or IUSA.

8.2 Source of principle

General Connection Principle No. 4 reflects the requirements of:

a) Schedules 5.1 and 5.1a of the *Rules*;

b) *good electricity industry practice*;

c) clause 6A.1.3(3) of the *Rules*;

d) the South Australian *applicable regulatory instruments* relating to the compatibility of new Generator/Load Systems (and the design of the *connection* arrangements for new Generator/Load Systems) with ElectraNet's *transmission system* so as not to prejudice *power system security* (see section 22(1)(b) of the *Electricity Act 1996* (SA));

e) the South Australian *applicable regulatory instruments* relating to the future design and planning of ElectraNet's *transmission system*; and

f) the requirements of Connection Principle No. 1.

8.3 Specific design requirements which result from applying this principle

a) The configuration of the *connection* arrangement for a new Generator/Load System will usually consist of IUSAs.

b) The IUSA and the DCA assets (and the boundary between the IUSA and DCA assets and the *Network User's facility* which will incorporate the new Generator/Load System) will be defined by ElectraNet for that *facility* and agreed in the related *connection agreement*.

c) A simple test that can be used as a 'rule of thumb' to determine whether an asset which will be installed as part of the *connection* arrangement for a new Generator/Load System will be treated as an IUSA asset or a DCA asset is whether there can be any *active power* transfer through the relevant asset when there is no *sent out generation* from the new Generator/Load System.

d) If the answer to (c) above is yes, then the asset is likely to be classified as an IUSA. Conversely, if the answer is no, then the asset is likely to be classified as a DCA asset.

e) Other types of boundaries relating to the *connection* arrangement for a new Generator/Load System will also be defined in the *connection agreement*.

f) For example:

(i) the physical boundary of a new *substation* will usually be defined by reference to the security fence for that new *substation*.

(ii) the electrical boundary between the *Network User's facility* and ElectraNet's *transmission system* will usually be on the *Network User's* side of the last isolation point within the IUSA. Normally this will be a high voltage isolator.

(iii) the boundary for Telecommunications and secondary systems will usually be a marshalling box built by ElectraNet in the IUSA.

g) ElectraNet has ongoing planning responsibility for the *transmission network* under the *Rules* and the South Australian *applicable regulatory instruments*.

h) ElectraNet is obliged by the *Rules* to give third party access to its *transmission network* and the *network services* provided by its *transmission network*. The IUSA will obviously form part of the *transmission network*.

i) If a third party owns an IUSA, access needs to be provided for other parties. ElectraNet will provide the functional requirements both for the initial development of the IUSA and any subsequent *augmentations*.

j) It follows that ElectraNet may be required to do work on IUSAs for a range of reasons, including in order to:

(i) allow other *Network Users* to *connect* their *facilities* to the *transmission network* at the particular geographic and *transmission network* location;

(ii) allow other *Network Users* to *connect* their *facilities* to the *transmission network* at another geographic and *transmission network* location; or

(iii) satisfy the *transmission network* technical requirements set out in the *Rules* or in the South Australian *applicable regulatory instruments*.

k) It also follows that the configuration of the connection for a new Generator/Load System to the *transmission network* must be designed in a manner which permits ElectraNet or a third party *Transmission Network Service Provider* to comply with its future obligations under the *Rules* and the South Australian *applicable regulatory instruments* in relation to its *transmission network*.

l) This includes the characteristics (i.e. area, location, proximity to relevant limitations, access rights etc.) of any land required for the purpose of locating any assets required to be constructed by ElectraNet or other

parties in order to *connect* the new Generator/Load System to the *transmission network*.

9. Connection Principle No. 5

9.1 Statement of principle

The configuration of any *connection* arrangement to the 275 kV *transmission network* or to the meshed (i.e. non-radial) 132 kV *transmission network* for a new Generator/Load System must be designed in a manner which permits:

a) the circuit breakers to operate; and

b) maintenance work in relation to the circuit breakers, without taking any *transmission lines* or any *Generator/load* units forming part of the *Connection Applicant's facility* out of service.

9.2 Source of principle

General Connection Principle No. 5 reflects the requirements of:

a) Schedules 5.1 and 5.1a of the *Rules*;

b) *good electricity industry practice*;

c) the South Australian *applicable regulatory instruments* relating to the compatibility of new Generator/Load Systems (and the design of the *connection* arrangements for new Generator/Load Systems) with ElectraNet's *transmission system* so as not to prejudice *power system security* (see section 22(1)(b) of the *Electricity Act 1996* (SA)); and

d) the requirements of Connection Principle No. 1.

9.3 Specific design requirements which result from applying this principle

a) Multiple inline circuit breakers degrade the performance, reliability and availability of the 275 kV *transmission network* and will usually not be permitted by ElectraNet.

b) 'Tee' *connections* to the 275 kV *transmission network* can cause or can potentially cause adverse impacts upon the safe, secure and *reliable* operation of the *power system*. 'Tee' *connections* to the 275 kV *transmission network* will not be permitted by ElectraNet.

c) The same problems (to a lesser extent) can arise in relation to the configuration of a *connection* arrangement to the meshed (i.e. non-radial) 132 kV *transmission network* for a new Generator/Load System.

d) As a consequence, the configuration of all new *connections* to the 275 kV *transmission network* or to the meshed (i.e. non-radial) 132 kV *transmission network* for a new Generator/Load System must be designed with at least a three circuit breaker mesh or ring arrangement configured as shown in Figure 12-2 or Figure 12-3. As per the OTR requirements, the substations will be laid out in such a way that enables the configuration to be expanded to or ultimately configured as a breaker and half arrangement.

e) In the case of the configuration of the *connection* arrangement to the meshed (i.e. non-radial) 132 kV *transmission network* for a new Generator/Load System, ElectraNet will consider a modification to the application of this design principle to allow a *connection* configuration of the type referred to in Section 12 if that type of *connection* configuration is consistent with Connection Principle No. 1 and is otherwise consistent with *good electricity industry practice*.

10. Connection Principle No. 6

10.1 Statement of principle

The configuration of any *connection* arrangement to a radial 132 kV *transmission line* may be designed in a manner which permits:

a) the relevant *connection point* circuit breaker to operate and in the case of a circuit breaker fail an inter-trip signal to be sent to the line circuit breaker(s); and

b) maintenance work in relation to that circuit breaker and/or the other *transmission system assets* related to that *connection* to be carried out, without taking any *transmission lines* or any *Generator/load* units forming part of the *Connection Applicant's facility* out of service.

10.2 Source of principle

General Connection Principle No. 6 reflects the requirements of:

a) Schedules 5.1 and 5.1a of the *Rules*;

b) *good electricity industry practice*;

c) the South Australian *applicable regulatory instruments* relating to the compatibility of new Generator/Load Systems (and the design of the *connection* arrangements for new Generator/Load Systems) with ElectraNet's *transmission system* so as not to prejudice *power system security* (see section 22(1)(b) of the *Electricity Act 1996* (SA)); and

d) the requirements of Connection Principle No. 1.

10.3 Specific design requirements which result from applying this principle

a) 'Tee' *connections* to a radial 132 kV transmission line will be permitted by ElectraNet if the *Connection Applicant* can demonstrate to ElectraNet's reasonable satisfaction that this type of *connection* configuration will not cause or be likely to cause adverse impacts upon the safe, secure and *reliable* operation of the *power system*.

11. Connection Principle No. 7

11.1 Statement of principle

In choosing a suitable location for:

a) the *connection* of a new Generator/Load System to the ElectraNet *transmission network*; and

b) the proposed *connection point*(s) for that new Generator/Load System,

Use reasonable endeavours with the reasonable requirements of the *Connection Applicant* to ensure that the site is not indirectly hindering access by other *Network Users* (both current and future) to the IUSA built at the site.

11.2 Source of principle

General Connection Principle No. 7 reflects the requirements of:

a) Schedules 5.1 and 5.1a of the *Rules*;

b) *good electricity industry practice*;

c) clause 6A.1.3(3) of the *Rules*;

d) the South Australian *applicable regulatory instruments* relating to the compatibility of new Generator/Load Systems (and the design of the *connection* arrangements for new Generator/Load Systems) with ElectraNet's *transmission system* so as not to prejudice *power system security* (see section 22(1)(b) of the *Electricity Act 1996* (SA));

e) the South Australian *applicable regulatory instruments* relating to the future design and planning of ElectraNet's *transmission system*; and

f) the requirements of Connection Principle No. 1.

11.3 Specific design requirements which result from applying this principle

a) Access to any new *substation* from the nearest public road must be unhindered and the relevant access road must be suitable for transportation of standard *transmission systems* primary and secondary plant.

b) The orientation and location of the proposed site for a new *substation* will be chosen within reason, to ensure that the proposed location of that new *substation* will not indirectly hinder access by other *Network Users* (both current and future) to the *prescribed transmission services* provided by ElectraNet's *transmission network* or *identified user shared assets* (including any new *substation*).

12. Typical connection designs for new Generator/Load Systems

12.1 Overview

a) This section sets out a number of examples of typical configurations for the *connection* of a new Generator/Load System to the *transmission network*. These are generally high-level single line diagrams, which are intended to show the basic switching configuration required, and to indicate the amount of plant that may be required to accommodate that new *connection* in a manner which is consistent with the principles outlined in this Guideline.

b) *Connection Applicant's* for new Generator/Load Systems will need to seek more information from ElectraNet on detailed plant technical specifications for their *connection* arrangements.

c) The example *connection* arrangements shown below represent the minimum *connection* configurations which will satisfy the Connection Principles.

d) *Connection Applicants* for new Generator/Load Systems may choose to negotiate *connection* arrangements that are more secure and reliable than the minimum arrangements shown below.

e) Some of the example *connection* arrangements shown below include information on the likely location of current transformers and isolation points. This information has only been included to highlight a specific feature of the example *connection* arrangement, and is not intended to represent a detailed overview of all necessary primary plant relating to the example *connection* arrangement.

f) The arrangements shown reflect the requirements of Principle 5 and are easily converted to the OTR's preferred breaker and a half configuration.

g) All of these configurations are the minimum arrangements that will allow ElectraNet to meet its specific reliability standards as required by the ESCOSA Electricity Transmission Code.

h) The configurations and division of assets must comply with the *Rules*. For information, the division of the assets according to the recent transmission connection rule change[3] is shown on the following page. The asset boundaries as per the revised *Rules* are colour coded and reflected in the suggested configurations that follow.

[3] The National Electricity Amendment (Transmission Connection and Planning Arrangements) Rule 2017 No. 4.

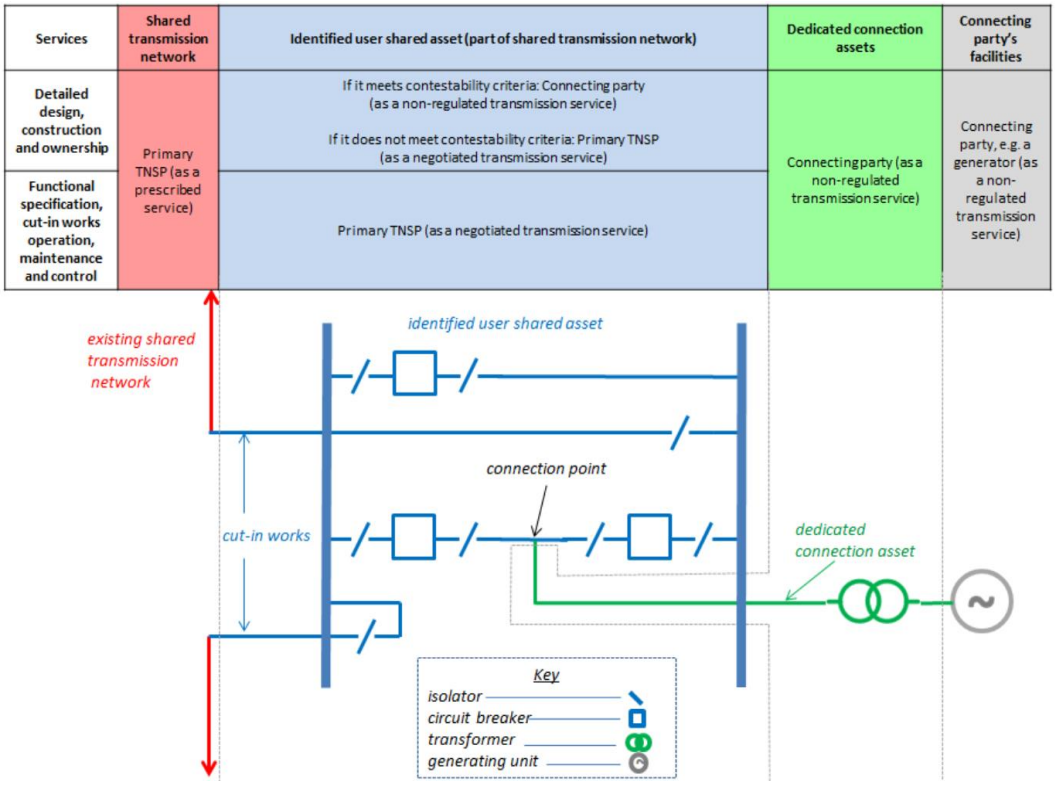

Figure 12-1: Asset Demarcation

12.2 Example connection arrangement for a new Generator/Load System to the 275kV transmission network

a) Figure 12-2 below shows a *switchyard* layout for the *connection* of a new Generator/Load System to the 275kV *transmission network*.

b) This basic arrangement layout will be used as a starting point for the design of the arrangement for the *connection* of a new Generator/Load System to an existing 275 kV transmission *line* that forms part of the *transmission network*.

c) This arrangement can be expanded to a breaker and half arrangement if other *connections* to the switching station eventuate in the future.

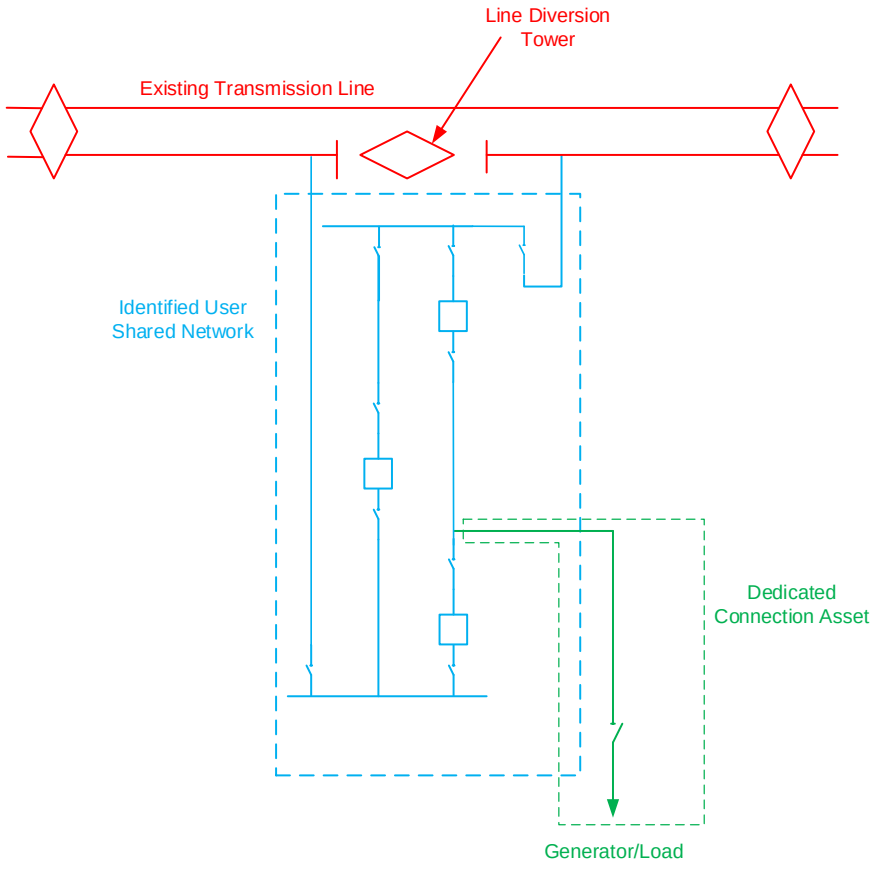

Figure 12-2: 275kV Network Single Connection.

12.3 Example connection arrangement for a new Generator/Load System to the 132 kV meshed transmission network

a) Figure 12-3 below shows a switchyard layout for the *connection* of a new Generator/Load System to the132kV meshed *transmission network*.

b) This basic arrangement layout will be used as a starting point for the design of the arrangement for the *connection* of a new Generator/Load System to an existing 132kV transmission line that forms part of the meshed *transmission network*.

c) This arrangement can be expanded to a breaker and half arrangement if other *connections* to the switching station eventuate in the future

d) If cutting into a double circuit line, consideration must be made in the initial design for the cut-in and switchyard to also support a cut-in from the second line.

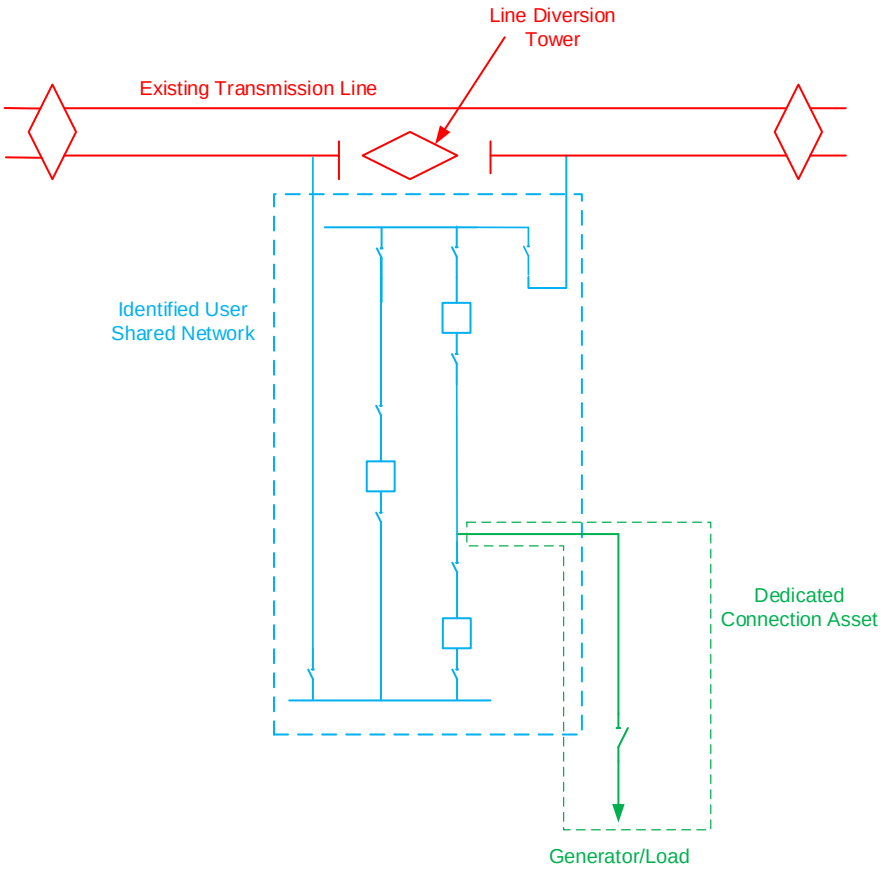

Figure 12-3: 132kV Meshed Network Single Connection

12.4 Example connection arrangement for a new Generator/Load System to the 132 kV radial transmission network

a) Figure 12-4 below shows a switchyard layout for the *connection* of a new Generator/Load System to the132kV radial *transmission network*.

b) This basic arrangement layout will be used as a starting point for the design of the arrangement for the *connection* of a new Generator/Load System to an existing 132kV transmission line that forms part of the 132kV radial *transmission network*.

c) This arrangement can be expanded to a breaker and half arrangement if other *connections* to the switching station eventuate in the future.

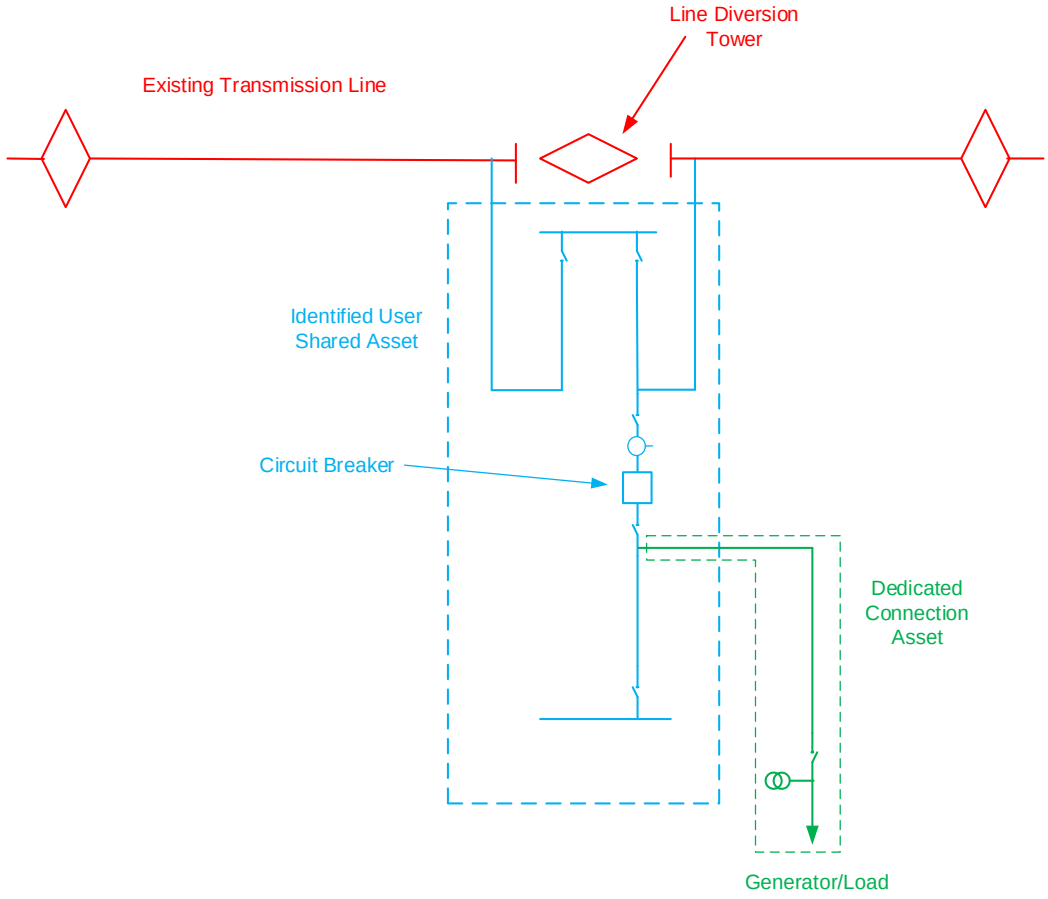

Figure 12-4: 132kV Radial network connection

Appendices

Appendix A National Electricity Rules Relevant to Connection Arrangements

Rule Clause	Summary of Clause
4.3.4(c) and (e)	*Network Service Providers* must arrange and maintain controls, monitoring and secure communication systems
4.3.4(g)	*Network Service Providers* must plan and operate *transmission system* in accordance with *power system* stability guidelines
5.1A2(c), and (d)[4]	technical terms and conditions must ensure *power system security* and *reliability*
5.1.A2(e)(1)[5]	the Rules should result in long term benefits to *Registered Participants* in terms of cost and *reliability* of the *national grid*
5.2.1(a)	*Registered Participants* are subject to relevant laws, the *Rules* and *good electricity industry practice* and relevant *Australian Standards*
5.2.1(b)	parties to *connection agreements* must ensure those *connection agreements* require *good electricity industry practice* and must operate their equipment in a manner to maintain a stable *power system*
5.2.3(b)	*Network Service Providers* must comply with *power system* performance and quality of *supply* standards, and *connection agreements*
5.2.3(d)(2)	*connection* arrangements and *connection agreements* must comply with all relevant provisions of the *Rules*
5.2.3(e1)(1)	*Network Service Providers* must arrange for management, maintenance and operation of its part of the *national grid* so that electricity may be transferred continuously at *connection points* up to *agreed capability*
5.2.3(e1)(3)	*Network Service Providers* must arrange for management, maintenance and operation of its *network* to minimise interruptions to *agreed capability* at *connection points* by using *good electricity industry practice*
5.2.3(e1)(4)	*Network Service Providers* must arrange for restoration of capacity as soon as reasonably practicable following an interruption at the *connection point*
5.2.3(f)	*Network Service Providers* must comply with *applicable regulatory instruments*
5.3.4A(b)(2) and (3)	a *negotiated access standard* must be set at a level that will not adversely affect *power system security* and will not adversely affect the quality of *supply* for other *Network Users*
5.3.5(d)	when preparing an offer to *connect, Network Service Providers* must liaise with *Registered Participants* with whom they have *connection* agreements, so as to maintain service levels and quality of *supply*
5.3.6(c)	Offers to *connect* must be fair and reasonable and consistent with the safe and *reliable* operation of the *power system* in accordance with the *Rules*
6A.1.3(2)	*Transmission Network Service Providers* must provide *transmission services* on terms of access consistent with Chapters 4, 5 and 6A of the *Rules*
S5.1a	*system standards*

[4] Prior to 1 July 2018, clause 5.1.3(c) and (d).

[5] Prior to 1 July 2018, clause 5.1.3(f)(1).

Rule Clause	Summary of Clause
S5.1	*network* performance requirements provided or coordinated by *Network Service Providers*
S5.2	conditions for connection of *Generators*
S5.3	conditions for connection of *Customers*

Note – this Appendix is intended to be used as for high-level guidance only and should not be relied upon by any person as legal or technical advice or otherwise - it lists certain clauses of the *Rules* which are relevant to Connection Arrangements. Users of this Guideline must ensure that they are familiar with all relevant *Rules* and obtain independent legal and professional advice with respect to the same.

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