Electricity Industry Act 2004

Pilbara Networks Rules
Appendix 5

Pilbara Harmonised Technical Rules

Version 1

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1 General

{Outline of this Chapter: This chapter 1 defines the scope of the *Rules* both as to their content and their application. It provides *Rules* of interpretation and refers to the dispute resolution process. It establishes the obligations of all parties and defines the methodology for variations, exemptions and amendments to these *Rules*.}

1.1 These rules

These *Rules* are Appendix 5 to, and form part of, the *Pilbara networks rules.*

1.2 Outline

{Outline of these harmonised technical rules: These *Rules* set out:

(a) the required performance standards for service quality in relation to the *power system*;

(b) the technical requirements for the design or operation of *equipment* including *generating units connected* to the *transmission* and *distribution systems*;

(c) the requirements for the operation of the *generating units*, *transmission* and *distribution systems* (including the operation in emergency situations or where there is a possibility of a person suffering injury);

(d) the obligations of *controllers* to test *equipment* in order to demonstrate compliance with the technical requirements referred to in subclause 1.2(b) and the operational requirements referred to in subclause 1.2(c);

(e) the procedures which apply if the *NSP* believes that a *controller's equipment* does not comply with the requirements of these *Rules*;

(f) the procedures for the inspection of a *controller's equipment*;

(g) procedures relating to the operation of *generating units*;

(h) the procedures for system tests carried out in relation to all or any part of the *transmission* and *distribution systems*;

(i) the requirements for control and protection settings for equipment including generating units connected to the transmission and distribution systems;

(j) the procedures for the commissioning and testing of new *equipment* including *generating units connected* to the *transmission* and *distribution systems*;

(k) the procedures for the disconnection of equipment including generating units from the transmission and distribution systems;

(l) the information which each *controller* is required to provide the *NSP* in relation to the operation of *equipment connected* to the *transmission* and *distribution systems* at the *controller's connection point* and how and when that information is to be provided;

(m) the requirements for the provision of a system for automatic under *frequency load shedding*;

(n) other matters relating to the transmission and distribution systems or equipment including generating units connected directly or indirectly to the transmission and distribution systems; and

(o) the transmission and distribution systems planning criteria.}

1.3 Application

See rule 4 of the *Pilbara networks rules*.

1.4 Commencement

See rule 3 and Appendix 4 of the *Pilbara networks rules*.

1.5 Interpretation

In these *Rules*:

(a) a word or phrase defined in the *Pilbara networks rules*, Act or the PNAC has the meaning given in those rules, that Act or that Code (as the case requires), unless redefined below; and

(b) the rules of interpretation in the *Pilbara networks rules* apply; and

(c) a word or phrase defined in the following table has the meaning given.

Label	Definition
access contract	means a "network access contract" as defined in the *rules*. {Note: In all cases this will include a connection agreement.}
accumulated synchronous time error	means the difference between Western Australia Standard Time and the time measured by integrating the instantaneous operating *frequency* of the *power system*.
active energy	means a measure of electrical *energy* flow, being the time integral of the product of *voltage* and the in-phase component of current flow across a *connection point*, expressed in watt hours (Wh) and multiples thereof
active power	means the rate at which *active energy* is transferred.
agreed capability	in relation to a *connection point* — means the capability to receive or send out *active power* and *reactive power* for that *connection point* determined in accordance with the relevant *access contract*.
ancillary service(s)	means an "essential system service" as defined in the *rules*.
augment	in relation to a *network* — means to increase the capability of the *network* to provide services.
Australian Standard (AS)	means the edition of a standard publication by Standards Australia (Standards Association of Australia) as at the date specified in the relevant clause or, where no date is specified, the most recent edition.
automatic reclose equipment	in relation to a *transmission or distribution line* — means the *equipment* which automatically recloses the relevant line's circuit

	breaker(s) following their opening as a result of the detection of a fault in the *transmission or distribution line*.
back-up protection system	means a *protection system* intended to supplement the *main protection system* in case the latter does not operate correctly, or to deal with faults in those parts of the *power system* that are not readily included in the operating zone of the *main protection system*. A *back-up protection system* may use the same circuit breakers as a *main protection system* and a *protection scheme* forming part of a *backup protection system* may be incorporated in the same *protection apparatus* as the *protection schemes* comprising the *main protection system*.
black start-up equipment	means the *equipment* required to provide a *generating unit* with the ability to start and synchronise without using electricity supplied from the *power system*.
busbar	means a common *connection point* in a *power station substation* or a *network substation*.
capacitor bank	means a type of electrical *equipment* used to generate *reactive power* and therefore support *voltage* levels on *transmission* or *distribution* lines.
cascading outage	means the occurrence of an uncontrollable succession of *outage*s, each of which is initiated by conditions (e.g. instability or over*load*ing) arising or made worse as a result of the event preceding it.
change	includes amendment, alteration, addition or deletion.
circuit breaker failure	means that the circuit breaker, having received a trip signal from a *protection scheme*, fails to interrupt fault current within its design operating time.
Commitment (in relation to testing of generating units)	means the commencement of the process of starting up and synchronising a *generating unit* to the *power system*.
connected	is defined in the *Pilbara networks rules*.
connection asset	means all of the *network* assets that are used only in order to transfer electricity to or from the *connection point*.
connection point	has the meaning given in the *rules*, but does not include an *interconnection point*
constant P & Q loads	means a particular type of *load* model which does not *change* its respective MW and MVAr consumption as the system *voltage* or *frequency* varies.
constraint	is defined in the *Pilbara networks rules*.
consumer	means a *person* who is the *controller* of *consumer equipment* at a *connection point*.

consumer equipment {a.k.a. **"consumer facility"** in the main rules}	means *equipment* used for, or in connection with, or to control, the consumption of *electricity* supplied out of the *network* at a *connection point*.
contingency event	means an event affecting the *power system* which the *NSP* expects would be likely to involve the failure or removal from operational service of a *generating unit* or *transmission/distribution* element.
control centre	means the *facility* used by the *NSP* for directing the minute to minute operation of the *power system*.
controllable	for the purpose of clause 2.2.11 — means that *voltages* at all major *busbars* in the *transmission and distribution system* must be able to be maintained continuously at the target level notwithstanding variations in *load* or that some *reactive* sources may have reached their output limits in the post-fault steady state.
control system	means the means of monitoring and controlling the operation of the *power system* or *equipment* including *generating units connected* to a *network*.
controller	is defined in the *rules*, and includes the *NSP* of an *excluded network*.
converter coupled generating unit	means a *generating unit* that uses *equipment* that *change*s the alternating current power produced by the *generating unit* to alternating-current power acceptable for transfer to the *power system* at a *connection point*.
credible contingency event	means a *single contingency event* of one of the following types: a) a three-phase to earth fault cleared by *disconnection* of the faulted component, with the fastest *main protection system* out of service; b) a single-phase to earth fault cleared by the *disconnection* of the faulted component, with the fastest *main protection system* out of service; c) a single-phase to earth fault cleared after unsuccessful highspeed single-phase auto-reclosure onto a persistent fault; d) a single-phase to earth *small zone fault* or a single-phase to earth fault followed by a *circuit breaker failure*, in either case cleared by the operation of the fastest available *protection scheme*; or e) a sudden *disconnection* of a system component, e.g. a *transmission line* or *generating unit*
critical fault clearance time	means the maximum *total fault clearance time* that the *power system* can withstand without one or both of the following conditions arising: a) instability; and b) unacceptable disturbance of *power system voltage* or *frequency*.

current rating	means the maximum current that may be permitted to flow (under defined conditions) through a *transmission* or *distribution* line or other item of *equipment* that forms part of a *power system*.
current transformer (CT)	means a *transformer* for use with meters or *protection* devices or both in which the current in the secondary winding is, within prescribed error limits, proportional to and in phase with the current in the primary winding.
damping ratio	means a standard mathematical parameter that characterises the shape of a damped sine wave.
de-energisation	means *disconnection* to attain a state that reverses *energisation.*
direction	means a *requirement* issued by the *NSP* to any *controller* requiring the *controller* to do any act or thing which the *NSP* considers necessary to maintain or re-establish *security* or to maintain or re-establish the *power system* in a *reliable* operating state in accordance with these *Rules*.
disconnect	means the operation of switching *equipment* or other action so as to prevent the flow of electricity at a *connection point*.
dispatch	is defined in the *Pilbara networks rules*.
dispatchable generating unit	means a *generating unit* that, in its satisfactory normal operating state, is capable of closely controlling its real power output.
distribution	means the functions performed by a *distribution system*, including transporting, and controlling the transportation of, electricity, and the provision of "services" (as defined in the Act).
distribution feeder	means a *medium voltage* radial circuit forming part of the *distribution system* that is supplied from a *zone substation*.
distribution system	is defined in the *Act*
dynamic performance	means the response and behaviour of *networks* and *facilities* which are *connected* to the *network*s when the normal operating state of the *power system* is disturbed.
embedded generating unit	means a *generating unit* which supplies on-site *loads* or *distribution* system *loads* and is *connected* either indirectly (i.e. by means of the *distribution* system) or directly to the *transmission system*.
emergency conditions	means the operating conditions applying after a significant *transmission system* element has been removed from service other than in a planned manner.
ENAC	means the *Electricity Networks Access Code (2004)* (WA)
energisation	means the act or process of operating switching *equipment* or starting up *generating unit*, which results in there being a non-zero *voltage*

	beyond a *connection point* or part of the *transmission system* or the *distribution* system.
energy	means *active energy* or *reactive energy*.
equipment	means any, or any component of, wires, apparatus, equipment, plant or building used, or to be used, for, or in connection with, or to control, the *generation*, *transmission*, *distribution* or consumption of electrical *energy* or making available electric power.
essential system services	is defined in the *Pilbara networks rules*
excitation control system	in relation to a *generating unit* — means the automatic *control system* that provides the field excitation for the *generating unit* of the *generating unit* (including excitation limiting devices and any *power system* stabiliser).
facility	means an installation comprising *equipment* and associated apparatus, buildings and necessary associated supporting resources used for or in connection with *generating*, conveying, transferring or consuming electricity, and may include: a) a power station; b) a substation; c) equipment by which electricity is consumed; and d) a control centre.
facility owner	is defined in clause 4.1.14.1.1(a).
fault clearance time	means the time interval between the occurrence of a fault and the fault clearance.
frequency	for alternating current electricity — means the number of cycles occurring in each second, measured in Hz.
frequency operating standards	means the standards which specify the *frequency* levels for the operation of the *power system* set out in clause 2.2.
frequency stability	means the ability of a *power system* to attain a steady *frequency* following a severe system disturbance that has resulted in a severe imbalance between *generation* and *load*. Instability that may result occurs in the form of sustained *frequency* swings leading to tripping of *generating units* or *loads* or both.
GEIP	is defined in the *Pilbara networks rules*
generated	in relation to a *generating unit* — means the amount of electricity produced by the *generating unit* as measured at its terminals.
generating unit	is defined in the *Pilbara networks rules*.

generation	means the production of electric power by converting another form of *energy* into electricity in a *generating unit*.
generator machine	means the machine used for the *generation* of electricity, excluding related or auxiliary *equipment*.
Gradual bumpless transfer	means the make-before-break transfer of a *load* between *the distribution system* and an islanded *generating unit* (or vice versa) where the time for which the *generating unit* is operated in parallel with the *distribution system* is limited to less than 60 seconds.
halving time	means the elapsed time required for the magnitude of a damped sine wave to reach half its initial value.
high voltage	means any nominal *voltage* at or above 35 kV
induction generating unit	means an alternating current *generating unit* whose rotor currents are produced by induction from its stator windings and, when driven above synchronous speed by an external source of mechanical power, converts mechanical power to electric power by means of a conventional induction machine.
inverter coupled generating unit	means a *generating unit* which uses a machine, device, or system that *change*s its direct-current power to alternating-current power acceptable for *power system connection*.
island	is defined in the *Pilbara networks rules*.
large disturbance	means a disturbance sufficiently large or severe as to prevent the linearization of system equations for the purposes of analysis. The resulting system response involves large excursions of system variables from their pre-disturbance values, and is influenced by nonlinear power-angle relationship and other non-linearity effects in *power systems*. *Large disturbance* is typically caused by a short circuit on a nearby *power system* component (for example, *transmission line*, *transformer*, etc.).
load	is defined in the *Pilbara networks rules*
load shedding	means reducing or *disconnecting load* from the *power system*.
low voltage	means any nominal *voltage* of 1 kV and below
main protection system	means a *protection system* that has the primary purpose of *disconnecting* specific *equipment* from the *transmission and distribution system* in the event of a fault occurring within that *equipment*.
maintenance conditions	means the operating conditions that exist when a significant element of the *transmission system* or the *distribution system* has been taken out of service in a planned manner so that maintenance can be carried out safely.

maximum fault current	means the current that will flow to a fault on an item of *equipment* when *maximum system conditions* prevail.
maximum system conditions	for any particular location in the *power system* — means those conditions that prevail when the maximum number of *generating units* that are normally *connected* at times of maximum *generation* are so *connected*.
medium voltage	means any nominal *voltage* above 1 kV and less than 35 kV
minimum fault current	means the current that will flow to a fault on an item of *equipment* when *minimum system conditions* prevail.
minimum system conditions	for any particular location in the *power system* — means those conditions that prevail when: a) the least number of *generating units* normally *connected* at times of minimum *generation* are so *connected*; and b) there is one *primary equipment outage*. The *primary equipment outage* is taken to be that which, in combination with the minimum *generation*, leads to the lowest fault current at the particular location for the fault type under consideration.
monitoring equipment	means the testing instruments and devices used to record the performance of *equipment* for comparison with expected performance.
nameplate rating	means the maximum continuous output or consumption specified either in units of *active power* (watts) or apparent power (volt-amperes) of an item of *equipment* as specified by the manufacturer.
network modelling procedure	is defined in the *Pilbara networks rules*.
nomenclature standards	means the standards approved by the *NSP* relating to numbering, terminology and abbreviations used for information transfer between *controllers* as provided for in clause 5.11.
non-dispatchable generating unit	means a *generating unit* that in its satisfactory normal operating state is not capable of closely controlling its real power output.
NSP	is defined in the *rules*, and does not include the *NSP* of an *excluded network*.
NWIS (for North West Interconnected System)	is defined in the *Pilbara networks rules*.
operational communication	means a communication concerning the arrangements for, or actual operation of, the *power system* in accordance with the *Rules*.
outage	is defined in the *Pilbara networks rules*.

peak load	means maximum *load*.
Pilbara networks rules	means the *Pilbara Networks Rules* made by the Minister under Part 8A of the *Electricity Industry Act 2004*, of which these Rules comprise Appendix 5.
PNAC	means the *Pilbara Networks Access Code (2004)* made by the Minister under Part 8A of the *Electricity Industry Act 2004*
point of common coupling	means the point on the *network* at which Horizon Power requires compliance with the Technical Rules clauses 2.3.3(a) and 2.3.4(a). Under normal circumstances this compliance is required at the connection point, but Horizon Power may, at its sole discretion, allow the "point of common coupling" to be at a point on the network upstream from the connection point, where it is reasonable to do so in accordance with good electricity industry practice.
power factor	means the ratio of the *active power* to the apparent power at a point.
power station {a.k.a. **"generation facility"** in the main rules}	means the one or more *generating units* at a particular location and the apparatus, *equipment*, buildings and necessary associated supporting resources for those *generating units*, including *black start equipment*, step-up *transformer*s, *substations* and the *power station control centre*.
power system	is defined in the *Pilbara networks rules*.
power system model	means the software model to be developed by the ISO under the *Pilbara networks rules*.
power system modelling procedure	means the procedure to be developed by the ISO under the *Pilbara networks rules*, which is referred to by this name in those *rules*.
power system operating procedures	means the procedures to be followed by the *NSP* and *controllers* in carrying out operations and maintenance activities on or in relation to *primary equipment* and *secondary equipment connected* to or forming part of the *power system* or *connection points*, as described in clause 5.8.
power system stability	means the ability of an electric *power system*, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact.
power transfer	means the instantaneous rate at which *active energy* is transferred between *connection points*.
power transfer capability	means the maximum permitted *power transfer* through a *network* or part thereof.
primary equipment	means apparatus which conducts *power system load* or conveys *power system voltage*.

proactive load shedding scheme	means a pre-planned scheme for reducing or *disconnecting load* from the *power system*.
protection	means the detection, limiting and removal of the effects of *primary equipment* faults from the *power system*; or the apparatus, device or system required to achieve this function.
protection apparatus	includes all relays, meters, power circuit breakers, synchronisers and other control devices necessary for the proper and safe operation of the *power system*.
protection scheme	means an arrangement of *secondary equipment* designed to protect *primary equipment* from damage by detecting a fault condition and sending a signal to *disconnect* the *primary equipment* from the *network*.
protection system	means a system designed to *disconnect* faulted *primary equipment* from the *network*, which includes one or more *protection schemes,* and which also includes the *primary equipment* used to effect the *disconnection*.
quality of supply	with respect to electricity — means technical attributes to a standard set out in clause 2.2, unless otherwise stated in these *Rules* or the relevant *access contract*.
rapid bumpless transfer	means the make-before-break transfer of a *load* between *the distribution system* and an islanded *generating unit* (or vice versa) where the time for which the *generating unit* is operated in parallel with the *distribution system* is limited to less than 1 second.
reactive energy	means a measure, in VAr hours (VArh) of the alternating exchange of stored *energy* in inductors and capacitors, which is the time-integral of the product of *voltage* and the out-of-phase component of current flow across a *connection point*.
reactive equipment	means that *equipment* which is normally provided specifically to be capable of providing or absorbing *reactive power*, and includes the *equipment* identified in subclause 5.3.1(f).
reactive power	means the rate at which *reactive energy* is transferred, measured in VArs. *Reactive power* is a necessary component of alternating current electricity which is separate from *active power* and is predominantly consumed in the creation of magnetic fields in motors and *transformers* and produced by *equipment* such as: a) alternating current *generating units*; b) capacitors, including the capacitive effect of parallel *transmission* wires; c) *synchronous condensers*. *Reactive power* is obtained from a combination of static and dynamic sources. Static sources include, for example, *reactors* and *capacitor bank*s, and the charging current of *transmission lines*. Dynamic sources include, for example, synchronous machines, operating as

	generating units or *synchronous compensators*, and *static VAr compensators*.
reactive power capability	means the maximum rate at which *reactive energy* may be transferred between a *generating unit* and a *connection point* as specified in the relevant *access contract*.
reactive power reserve	means unutilised sources of *reactive power* arranged to be available to cater for the possibility of the unavailability of another source of *reactive power* or increased requirements for *reactive power*.
reactor	means a device, similar to a *transformer*, arranged to be *connected* into the *network* during periods of low *load* demand or low *reactive power* demand to counteract the natural capacitive effects of long *transmission lines* in generating excess *reactive power* and so correct any *transmission voltage* effects during these periods.
region	means an area determined by the *NSP* to be a *region*, being an area served by a particular part of the *transmission system* containing one or more: a) concentrated areas of *load* or *loads* with a significant combined consumption capability; or b) concentrated areas containing one or more *generating units* with significant combined generating capability, or both.
reliability	is defined in the Pilbara networks rules.
remote control equipment (RCE)	means *equipment* installed to enable the *NSP* to control a *generating unit* circuit breaker or other circuit breaker remotely.
Remote monitoring equipment (**RME**)	means *equipment* installed to enable the monitoring of other *equipment* from a remote *control centre*, and includes a remote terminal unit (*RTU*).
reserve	means the *active power* and *reactive power* available to the *power system* at a nominated time but not currently utilised.
rotor angle stability	means the ability of synchronous machines on an *interconnected power system* to remain in *synchronism* after being subjected to a disturbance, and which may comprise small-disturbance or transient stability, or both. Instability from a disturbance may occur in the form of increasing angular swings of some *generating units*, leading to loss of *synchronism* between *generating units*. Loss of *synchronism* can occur between one machine and the rest of the *power system*, or between groups of machines, with *synchronism* being maintained within each group after separating from each other.
RTU	means a remote terminal unit installed within a *substation* to enable monitoring and control of *equipment* from a remote *control centre*.

SCADA system	means supervisory control and data acquisition *equipment* which enables the *NSP* monitor continuously and remotely, and to a limited extent control, the import or export of electricity from or to the *power system*.
secondary equipment	means *equipment* within a *facility* or the electricity *network*s which does not carry the *energy* being transferred, but which is required for control, *protection* or operation of other *equipment* that does carry such *energy*.
security	is defined in the *Pilbara networks rules*.
sensitivity	in relation to *protection schemes* — has the meaning in clause 2.6.6.
service provider	in relation to a *network* — means a person who owns or operates the *network.*
shunt capacitor	means a type of *equipment connected* to a *network* to generate *reactive power*.
shunt reactor	means a type of *equipment connected* to a *network* to absorb *reactive power*.
single contingency	in respect of a *transmission system* — means a sequence of related events which result in the removal from service of one *transmission line*, *transformer* or other item of *equipment*. The sequence of events may include the application and clearance of a fault of defined severity.
small disturbance	means a disturbance sufficiently small to permit the linearization of system equations for the purposes of analysis. The resulting system response involves small excursions of system variables from their pre-disturbance values. *Small disturbances* may be caused by routine switching (for example, line or capacitor), *transformer* tap *changes*, *generating unit* AVR set point *changes*, *changes* in the *connected load*, etc.
small-disturbance rotor angle stability	means the ability of the *power system* to maintain *synchronism* under *small disturbances*.
small use customer	means a *consumer* that consumes less than 160 MWh of electricity per annum.
small zone fault	means a fault which occurs on an area of *equipment* that is within the zone of detection of a *protection scheme*, but for which not all contributions to the fault will be cleared by the circuit breaker(s) tripped by that *protection scheme*. For example, a fault in the area of *equipment* between a *current transformer* and a circuit breaker, fed from the *current transformer* side, may be a *small zone fault*.
spare capacity	means any portion of firm capacity or non-firm capacity not committed to existing *controllers*.

standard consultation procedure	is defined in the *Pilbara networks rules*.
static excitation system	means an *excitation control system* in which the power to the rotor of a *synchronous generating unit* is transmitted through high power solid-state electronic devices.
static VAr compensator	means a device provided on a *network* specifically to provide the ability to generate and absorb *reactive power* and to respond automatically and rapidly to *voltage* fluctuations or *voltage* instability arising from a disturbance or disruption on the *network*.
static synchronous compensator (STATCOM)	means a device provided on a *network* specifically to provide the ability to generate and absorb *reactive power* and to respond automatically and rapidly to *voltage* fluctuations or *voltage* instability arising from a disturbance or disruption on the *network.*
statutory instruments	means all relevant instruments made under a *written law* including all *directions*, notices, orders and other instruments given or made under a *written law*.
substation	means a *facility* at which lines are switched for operational purposes, and which may include one or more *transformers* so that some *connected* lines operate at different nominal *voltages* to others.
supply	means the delivery of electricity as defined in the *Act*.
supply transformer	means a *transformer*, forming part of the *transmission system*, which delivers electricity to the *distribution system* by converting it from the *voltage* of the *transmission system* to the *voltage* of the *distribution system*.
synchronisation	means the act of synchronising a *generating unit* to the *power system*.
synchronism	means a condition in which all machines of the synchronous type (*generating units* and motors) that are *connected* to a *network* rotate at the same average speed, resulting in controlled sharing of the transfer of power. Loss of *synchronism* causes uncontrolled transfers of power between machine groups, causing severe and widespread disturbances of *supply* to *controllers*, *disconnection* of *transmission lines*, possible damage to synchronous machines and system shutdown.
synchronous condenser or **synchronous compensator**	means an item of *equipment*, similar in construction to a *generating unit* of the *synchronous generating unit* category, which operates at the equivalent speed of the *frequency* of the *power system*, provided specifically to generate or absorb *reactive power* through the adjustment of rotor current.
synchronous generating unit voltage control	means the automatic *voltage control system* of a *generating unit* of the *synchronous generating unit* category which *changes* the output *voltage* of the *generating unit* through the adjustment of the

	generating unit rotor current and effectively *changes* the *reactive power* output from that *generating unit*.
synchronous generating unit	means the alternating current *generating units* which operate at the equivalent speed of the *frequency* of the *power system* in its normal operating state.
tap-changing transformer	means a *transformer* with the capability to allow internal adjustment of output *voltages* which can be automatically or manually initiated while on-line and which is used as a major component in the control of the *voltage* of the *network* in conjunction with the operation of *reactive equipment*. The *connection point* of a *generating unit* may have an associated *tap-changing transformer*, usually provided by the *generator*.
technical minimum	means the minimum continuous *active power* output of a *generating unit*.
thermal generating unit	means a *generating unit* which uses fuel combustion for electricity *generation*.
total fault clearance time	means the time from fault inception to the time of complete fault interruption by a circuit breaker or circuit breakers. This is to be taken, as a minimum, to be equal to 10 milliseconds plus the circuit breaker maximum break time plus the maximum *protection* operating time.
transformer	means a piece of *equipment* that reduces or increases the *voltage* of alternating current.
transformer tap position	means where a tap changer is fitted to a *transformer*, each tap position represents a *change* in *voltage* ratio of the *transformer* which can be manually or automatically adjusted to *change* the *transformer* output *voltage*. The tap position is used as a reference for the output *voltage* of the *transformer*.
transient rotor angle stability	means the ability of the *power system* to maintain *synchronism* when subjected to severe disturbances, for example a short circuit on a nearby *transmission line*. The resulting system response involves large excursions of *generating unit* rotor angles and is influenced by the non-linear power-angle relationship.
transmission	means the functions performed by a *transmission system*, including transporting, and controlling the transportation of, electricity, and the provision of "services" (as defined in the Act).
transmission element	is defined in the *Pilbara networks rules*.
transmission equipment	means the *equipment* associated with the function or operation of a *transmission line* or an associated *substation*, which may include *transformers*, circuit breakers, *reactive equipment* and *monitoring equipment* and control *equipment*.
transmission line	means a power line that is part of a *transmission system*.

transmission system	is defined in the *Act*, and includes equipment such as static *reactive power* compensators, which is operated at *voltage*s below 66 kV, provided that the *equipment* is used primarily for, or in connection with, or to control, the transportation of *electricity* at *voltage*s of 66 kV or higher.
transmission voltage	is defined in the *Pilbara networks rules*.
trip circuit supervision	means a function incorporated within a *protection scheme* that results in alarming for the loss of integrity of the *protection scheme's* trip circuit. *Trip circuit supervision* supervises a *protection scheme*'s trip *supply* together with the integrity of associated wiring, cabling and circuit breaker trip coil.
trip supply supervision	means a function incorporated within a *protection scheme* that, results in alarming for loss of trip *supply*.
turbine control system	means the automatic *control system* which regulates the speed and power output of a *generating unit* through the control of the rate of entry into the *generating unit* of the primary *energy* input (for example, steam, gas or water).
two fully independent protection schemes of differing principle	means *protection schemes* having *differing principle*s of operation and which, in combination, provide dependable detection of faults on the protected *primary equipment* and operate within a specified time, despite any single failure to operate of the *secondary equipment*. To achieve this, complete *secondary equipment* redundancy is required, including *current transformer* and *voltage transformer* secondaries, auxiliary supplies, signalling systems, cabling, wiring, and circuit breaker trip coils. Auxiliary supplies include DC supplies for *protection* purposes. Therefore, to satisfy the redundancy requirements, each *protection scheme* would need to have its own independent battery and battery charger system *supplying* all that *protection scheme*'s trip functions. In addition the relays of each *protection scheme* must be grouped in separate physical locations (which need not be in different panels). Furthermore the two *protection schemes* must either use different methods of operation or, alternatively, have been designed and manufactured by different organisations.
voltage	means the electronic force or electric potential between two points that gives rise to the flow of electricity.
voltage stability	means the ability of a *power system* to attain steady *voltages* at all *busbars* after being subjected to a disturbance from a given operating condition. Instability that may result occurs in the form of a progressive fall or rise of *voltages* at some *busbars*. Possible outcomes of *voltage* instability are loss of *load* in an area, or the tripping of *transmission lines* and other elements, including *generating units*, by their protective systems leading to *cascading outages*.

voltage transformer (VT)	means a *transformer* for use with meters and/or *protection* devices in which the *voltage* across the secondary terminals is, within prescribed error limits, proportional to and in phase with the *voltage* across the primary terminals.
WA Distribution Connection Manual (WADCM)	means the *WA Distribution Connection Manual* and all subsequent Addendum, available from http://www.westernpower.com.au/localgovernments-guidelines-and-manuals.html
WA Electrical Requirements (WAER)	means the *WA Electrical Requirements* issued under Regulation 49 of the *Electricity (Licensing) Regulations (1991)* (WA) and available from Internet site http://www.energysafety.wa.gov.au/
wind farm	means a *power station* consisting of one or more wind powered *generating units*.
zone substation	means a *substation* that transforms electricity from a *transmission system voltage* to a *distribution system voltage*.

1.6 NSPs and controllers to comply with objectives and act reasonably

1.6.1 NSPs and controllers must act consistently with objectives

NSPs and *controllers* must act in a manner consistent with the objectives of these *Rules* as set out in rule 58 of the *Pilbara networks rules*.

1.6.2 NSPs and controllers must act reasonably

(a) *NSPs* and *controllers* must act reasonably towards each other in regard to all matters under these *Rules*.

(b) Whenever the *NSP* or a *controller* is required to make a determination, form an opinion, give approval, make any request, exercise a discretion or perform any act under these *Rules*, it must be formed, given, made, exercised or performed reasonably and in a manner that is consistent with the objectives of these *Rules* and be based on reasonable grounds, and not unduly, capriciously or arbitrarily refused, delayed or conditioned.

1.7 Dispute resolution

See Chapter 13 of the *Pilbara networks rules*.

1.8 Obligations

1.8.1 General

(a) *Controllers* and *NSPs* must maintain and operate (or ensure their authorised *representatives* maintain and operate) all *equipment* that is part of their respective facilities in accordance with:

(1) relevant laws; and

(2) the performance standards in, and other requirements of, these Rules; and

(3) good electricity industry practice.

(b) *An NSP* must comply with the *Pilbara networks rules* regarding power flows and power quality at interconnection points between its *network* and other *networks*.

1.8.2 NSPs' other obligations

(a) An *NSP* must advise a *network user* of any expected interruption or reduced level of service at its *connection point*.

(b) An *NSP* must manage, operate and *maintain* its network in such a way that (except to the extent that an *access contract* or a *constraint direction* provides otherwise):

(1) When the *power system* is in the normal operating state, electricity may be transferred continuously at a *connection point* up to the *agreed capability* of that *connection point*;

(2) minimises to the extent reasonably practicable the number and impact of interruptions or service level reductions to *controllers*; and

(3) the *agreed capability* of a *connection point* is restored as soon as reasonably practicable following any interruption or reduction in service level at that *connection point*.

(c) Clause 1.8.1(b) does not limit any other obligation or requirement imposed on an *NSP* by law or contract.

1.9 Variations and exemptions

See rules 57 and 64 of the *Pilbara networks rules*.

2 Transmission and distribution system performance and planning criteria

2.1 [not used]

2.2 Power system performance standards

{Note: These standards are called by the *Pilbara networks rules*, especially in Chapter 7.}

2.2.1 Frequency variations

(a) The nominal operating *frequency* of the *power system* is 50 Hz.

(b) The *accumulated synchronous time error* must be less than 10 seconds for 99% of the time over a period of 24 hours.

(c) The *frequency operating standards* for the *power system* are summarised in Table 2.1.

Table 2.1 – Frequency Operating Standards

Condition	*Frequency* Band	Target Recovery
No *contingency event* or *load* event	49.75 to 50.25 Hz	
Single contingency event	49.00 to 51.00 Hz	49.75 to 50.25 Hz within 25 minutes
Multiple *Contingency event*	48.00 to 52.00 Hz	49.75 to 50.25 Hz within 25 minutes

(d) The *power system* must remain within the *frequency operating standards* under all credible *power system load* and generation patterns and the most severe credible contingency event.

(e) Clause 2.2.1(d) must be complied with, without the use of *load shedding*, unless:

a access is unavailable to adequate spinning reserve procured and enabled in accordance with the *Pilbara networks rules*; or

b an *island* forms in the *power system*, and access is unavailable within the *island* to adequate spinning reserve procured and enabled in accordance with the *Pilbara networks rules* — in which case *load shedding* may be used to comply with clause 2.2.1(d) within the *island*; or

c a multiple contingency event occurs.

(f) *Load shedding* facilities (described in clause 2.3.2) may be used to ensure compliance with the *frequency operating standards* prescribed in Table 2.1 following a multiple *contingency event*.

2.2.2 Steady State Power Frequency Voltage

(a) Except as a consequence of a non-credible *contingency event*, the minimum steady state *voltage* on the *transmission system* and those parts of the *distribution system* operating at *voltages* of 6.6 kV and above must be 90% of nominal *voltage* and the maximum steady state *voltage* must be 110% of nominal *voltage*. For those parts of the *distribution system* operating at low voltage, the steady state *voltage* must be within:

(1) ± 6% of the nominal *voltage* during normal operating state,

(2) ± 8% of the nominal *voltage* during *maintenance conditions*,

(3) ± 10% of the nominal *voltage* during *emergency conditions*.

(b) Step *changes* in steady state *voltage* levels resulting from switching operations must not exceed the limits given in Table 2.3.

(c) Where more precise control of *voltage* is required than is provided for under subclause 2.2.2(a), a target range of *voltage* magnitude at a *connection point*, may be agreed with a *controller* and specified in an *access contract*. This may include different target ranges under normal and post-contingency conditions (and how these may vary with *load*). Where more than one *controller* is supplied at a *connection point* such that independent control of the *voltage* supplied to an individual *controller* at that *connection point* is not possible, a target must be agreed by all relevant *controllers* and the *NSP*. Where *voltage* magnitude targets are specified in an *access contract*, *controllers* should allow for short-time variations within 5% of the target values in the design of their *equipment*.

Table 2.3 – Step – change voltage limits

Cause	Pre-switching *(quasi steady-state) and during tap –changing*			Post-switching (final steady state)	
				Transmission **(≥ 66 kV)**	***Distribution*** **(< 66 kV)**
Routine Switching[1]	**r** **(hour^{-1})**	Δ **U_{dyn}[3]/U_N[4]**		*Transmission voltages* must be between 110% and 90% of nominal *voltage*	*Must attain steady state limits*
		Distribution	***Transmission***		
	r ≤ 1	±.4.0%	±.3.00%		
	1< r ≤ 10	±.3.0%	±.2.5.0%		
	10< r ≤100	±.2.0%	±.1.5%		
	100< r ≤ 1000	±.1.25%	±.1.0%		
Infrequent Switching [2]	+6%, –10% (max)			*Transmission voltages* must be between 110% and 90% of nominal *voltage*	*Must attain steady state limits*

{NOTES:

1. For example, capacitor switching, *transformer* tap action, motor starting, start-up and shutdown of *generating units*.
2. For example, tripping of *generating units*, *loads*, lines and other components.
3. Δ **U_{dyn}** is the dynamic *voltage change* which has the same meaning as in *AS*/NZS 61000.3.7.
4. **U_N** is the nominal *voltage*.}

2.2.3 Flicker

(a) Rapid *voltage* fluctuations cause *changes* to the luminance of lamps which can create the visual phenomenon called flicker. Flicker severity is characterised by the following two quantities, which are defined in *AS*/NZS 61000.3.7:2001,

(1) P_{st} - short-term flicker severity term (obtained for each 10 minute period);

(2) P_{lt} - long-term flicker severity (obtained for each 2 hour period).

(b) Under normal operating conditions, flicker severity caused by *voltage* fluctuation in the *transmission* and *distribution system* must be within the planning levels shown in Table 2.4 for 99% of the time.

Table 2.4 – Planning levels for flicker severity

Flicker Severity Quantity	LV (415 V)	MV (≤ 35 kV)	HV-EHV (> 35 kV)
P_{st}	1.0	0.9	0.8
P_{lt}	0.8	0.7	0.6

{NOTES:

1. These values were chosen on the assumption that the transfer coefficients between MV or HV systems and LV systems are unity. The planning levels could be increased in accordance with *AS* 61000.3.7 (2001).
2. The planning levels in Table 2.4 are not intended to apply to flicker arising from *contingency* and other *uncontrollable* events in the *power system*, etc.}

2.2.4 Harmonics

Under normal operating conditions, the harmonic *voltage* in the *transmission* and *distribution systems* must not exceed the planning levels shown in Table 2.5 and Table 2.6 (as applicable) appropriate to the *voltage* level, whereas the inter harmonics *voltage* must not exceed the planning levels of *AS*/NZS 61000.3.6 (2001).

Table 2.5 – Distribution planning levels for harmonic voltage in networks with system voltage less than or equal to 35 kV (in percent of the nominal voltage)

Odd harmonics non multiple of 3		Odd harmonics multiple of 3		Even harmonics	
Order h	Harmonic *voltage* %	Order h	Harmonic *voltage* %	Order h	Harmonic *voltage* %
5	5	3	4	2	1.6
7	4	9	1.2	4	1
11	3	15	0.3	6	0.5
13	2.5	21	0.2	8	0.4
17	1.6	>21	0.2	10	0.4
19	1.2			12	0.2

23	1.2			>12	0.2
25	1.2				
>25	$0.2 + 0.5\frac{25}{h}$				
Total harmonic distortion (THD): 6.5 %					

Table 2.6 – Transmission planning levels for harmonic voltage in networks with system voltage above 35 kV (in percent of the nominal voltage)

Odd harmonics non multiple of 3		**Odd harmonics multiple of 3**		**Even harmonics**	
Order h	**Harmonic *voltage* %**	**Order h**	**Harmonic *voltage* %**	**Order h**	**Harmonic *voltage* %**
5	2	3	2	2	1.5
7	2	9	1	4	1
11	1.5	15	0.3	6	0.5
13	1.5	21	0.2	8	0.4
17	1	>21	0.2	10	0.4
19	1			12	0.2
23	0.7			>12	0.2
25	0.7				
>25	$0.2 + 0.5\frac{25}{h}$				
Total harmonic distortion (THD): 3 %					

Notes:

1. The planning levels in Table 2.5 and Table 2.6 are not intended to apply to harmonics arising from uncontrollable events such as geomagnetic storms, etc.

2. The total harmonic distortion (THD) is calculated from the formula:

$$THD = \underline{Unom} \sum \sqrt{40\ (Uh)2\ U1\ h=2}$$

Where:

U_{nom} = nominal *voltage* of a system

U_1 = fundamental *voltage*

U_h = harmonic *voltage* of order h expressed in percent of the nominal *voltage*

3. Table 2.5 and Table 2.6 are consistent with *AS* 61000 (2001)

2.2.5 Negative phase sequence voltage

The 30 minute average level of negative phase sequence *voltage* at all *connection points* must be equal to or less than the values set out in Table 2.7.

Table 2.7 – Limits for negative phase sequence component of voltage (in percent of the positive phase sequence component)

Nominal System *Voltage* (kV)	Negative Sequence *Voltage* (%)
> 100	1
10 – 100	1.5
< 10	2

2.2.6 Electromagnetic interference

Electromagnetic interference caused by *equipment* forming part of the *transmission* and *distribution system* must not exceed the limits set out in Tables 1 and 2 of *Australian Standard AS* 2344 (1997).

2.2.7 Transient rotor angle stability

All *generating units* connected to the *transmission system* and *generating units* within *power stations* that are *connected* to the *distribution system* must remain in *synchronism* following a *credible contingency event*.

2.2.8 Oscillatory rotor angle stability

System oscillations originating from system electro-mechanical characteristics, electromagnetic effect or non-linearity of system components, and triggered by any *small disturbance* or *large disturbance* in the *power system*, must remain within the *small disturbance rotor angle stability* criteria and the *power system* must return to a stable operating state following the disturbance. The *small disturbance rotor angle stability* criteria are:

(a) The *damping ratio* of electromechanical oscillations must be at least 0.1.

(b) For electro-mechanical oscillations as a result of a *small disturbance*, the *damping ratio* of the oscillation must be at least 0.5.

(c) In addition to the requirements of subclause 2.2.8(a), the *halving time* of any electro-mechanical oscillations must not exceed 5 seconds.

2.2.9 Short term voltage stability

(a) Short term *voltage stability* is concerned with the *power system* surviving an initial disturbance and reaching a satisfactory new steady state.

(b) Stable *voltage* control must be maintained following the most severe *credible contingency event*.

2.2.10 Temporary over-voltages

As a consequence of a *credible contingency event*, the power *frequency voltage* at all locations in the *power system* must remain within the over-*voltage* envelope shown in Figure 2.1.

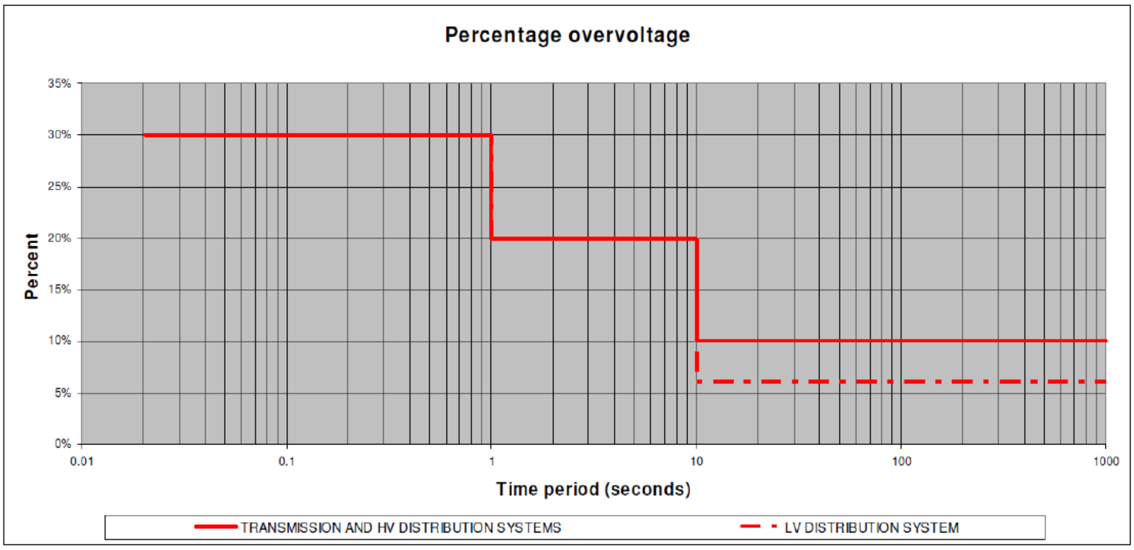

Figure 2.1 – Percentage Overvoltage Envelope

2.2.11 Long term voltage stability

(a) Long term *voltage stability* includes consideration of slow dynamic processes in the *power system* that are characterised by time constants of the order of tens of seconds or minutes.

(b) The long term *voltage stability* criterion is that the *voltage* at all locations in the *power system* must be stable and *controllable* following the most onerous post-contingent system state following the occurrence of any *credible contingency event* under all credible *load* conditions and *generation* patterns.

2.3 Obligations of NSP in relation to power system performance

2.3.1 Frequency control

(a) *NSPs* must design and install an automatic under-*frequency load shedding* system on the *transmission* and *distribution systems* to ensure that the *frequency* performance of the *power system* following a *contingency event*, as specified in Table 2.1, can be achieved. Further information on the technical requirements of this system is given in clause 2.4.

(b) The automatic *under-frequency load shedding* systems for the *power system* must be designed to ensure that, should a *contingency event* occur that results in the formation of islands, each island in the *power system* that contains *generating units* has sufficient *load shedding* facilities to aid recovery of the *frequency* to the normal band within the time frames specified in Table 2.1.

(c) *NSPs* may require commercial and industrial *consumers* to make a portion of their *load* available for automatic under-*frequency* or under*voltage load shedding* or both and may also require a commercial or industrial *consumer* to provide control and *monitoring equipment* for the *load shedding* facilities. The amount of *load* to be available for shedding and the frequencies or *voltages* or both at which *load* must be shed must be negotiated between the *NSP* and the *controller* or, failing agreement between them, must be as determined by an *access dispute arbitration* or as specified by the *ISO* (consistent with Table 2.9 for the *NWIS* only), and must be specified in the relevant *access contract*.

2.3.2 Load to be available for disconnection

(a) *NSPs* must ensure that up to 75% of the *power system load* at any time is available for *disconnection* under anyone or more of:

(1) the automatic control of under-*frequency* relays;

(2) manual or automatic control from *control centres*; and

(3) the automatic control of under *voltage* relays.

(b) To satisfy this overall criterion, the *NSP* may, at its discretion, arrange for up to 90% of the *power system load* to be available for automatic *disconnection*, if necessary to ensure that the *frequency* performance standard specified in clause 2.2.1 can be met for all credible *power system load* and *generation* patterns. *NSPs* must advise *controllers* if this additional requirement is necessary.

(c) *NSPs* may install special *load shedding* arrangements to cater for abnormal operating conditions.

(d) Arrangements for *load shedding* must include the opening of circuits in the *distribution system* and may include the opening of circuits in the *transmission system*.

(e) The *NSP* must use its best endeavours to assign feeders to stages within the *load shedding* system so that *loads* supplying *essential system services* are not made available for shedding or are given a lower *load shedding* priority than other *loads*.

2.3.3 Flicker

(a) To ensure that the flicker level at any *point of common coupling* on the *network* does not exceed the maximum levels specified in clause 2.2.3, the

NSP must, where necessary and after consultation with the relevant *controllers*, allocate flicker emission limits to *controllers* in accordance with subclauses 2.3.3(b) and 2.3.3(c).

(b) *The NSP* must allocate contributions to limits no more onerous than the lesser of the acceptance levels determined in accordance with the stage 1 and the stage 2 evaluation procedures defined in *AS*/NZS 61000.3.7 (2001).

(c) If the *controller* cannot meet the contribution calculated by using the method of subclause 2.2.3(b), then the *NSP* may use, in consultation with the party seeking connection, the stage 3 evaluation procedure defined in *AS*/NZS 61000.3.7 (2001).

(d) *NSPs* must verify compliance of *controllers* with allocated flicker emission levels. The contribution may be assessed by direct measurement or by calculation from the available data for the *load* and the *power system*. In verifying compliance, measurements of flicker must be carried out according to *AS*/NZS 61000.3.7 (2001).

2.3.4 Harmonics

(a) To ensure that the harmonic or inter-harmonic level at any *point of common coupling* on the *network* does not exceed the maximum levels specified in clause 2.2.4, the *NSP* must, where necessary and after consultation with the relevant *controllers*, allocate harmonic emission limits to *controllers* in accordance with *AS*/NZS 61000.3.6 (2001).

(b) The *NSP* must verify compliance of *controllers* with allocated harmonic or inter-harmonic emission levels. The contribution may be assessed by direct measurement or by calculation from the available data for the *load* and the *power system*.

(c) The measurement must be carried out according to *AS*/NZS 61000.4.7 (1999). Harmonics must generally be measured up to h=40. However, higher order harmonics up to 100th order may be measured if the *NSP* reasonably considers them to be of material concern.

2.3.5 Negative phase sequence voltage

(a) If the maximum level of negative phase sequence *voltage*, as specified in Table 2.7, is exceeded at any *connection point* on the *network*, the *NSP* must remedy the problem to the extent that it is caused by the *network*.

(b) If, in the *NSP's* opinion, the problem is caused by an unbalance in the phase currents within a *controller's equipment* or facilities, it must require the *controller* to remedy the unbalance.

2.3.6 Electromagnetic interference

The *NSP* must respond to all complaints regarding electromagnetic interference in a timely manner and undertake any necessary tests to determine whether or not the interference is caused by *equipment* forming part of the *network*, and whether or not it exceeds the limits specified in clause 2.2.6. If the complaint is justified, the *NSP* must, as soon as reasonably practicable, take any necessary action to reduce the interference to below the maximum prescribed levels.

2.3.7 Power system stability and dynamic performance

2.3.7.1 Short term stability

(a) The *NSP* must plan, design and construct the *network* so that the short term *power system stability* and *dynamic performance* criteria specified in clauses 2.2.7 to 2.2.10 are met for credible system *load* and *generation* patterns, and for the particular location, the most critical, *credible contingency event* without exceeding the rating of any *power system* component or, where applicable, the allocated *power transfer* capacity.

(b) To ensure compliance with subclause 2.3.7.1(a), the *NSP* must simulate the short term *dynamic performance* of the *power system*. Dynamic models of individual components must be verified and documented.

(c) In planning the transmission and distribution system the NSP must:

(1) assume a *transmission* and *distribution system* operating configuration with *equipment* out of service for maintenance where this is provided for in the planning criteria specified in clause 2.5; and

(2) use a total fault clearance time determined by the slower of the two protection schemes, where the main protection system includes two protection schemes. Where the main protection system includes only one protection scheme, the back-up protection system total fault clearance time must be used for simulations

(d) The *NSP* must determine the credible system *load* and *generation* patterns to be assumed for the purpose of short term stability analysis. Where practical, the *NSP* should set, *power transfer* limits for different *power system* conditions, as provided for in subclause 2.3.8(a), so as not to unnecessarily restrict the *power transfer* capacity made available to *controllers*.

2.3.7.2 Short term voltage stability

(a) The *NSP* must assess the compliance of the *network* with the different short term *voltage stability* criteria specified in clause 2.2 using simulation of the system response with the best available models of *voltage*-dependent *loads* (including *representative* separate models of motor *loads* where appropriate).

(b) The assessment must be made using simulation of the system response with the short-term overload capability of the *voltage / excitation control system* capability of each *generating unit* or other reactive source represented (magnitude and duration). This is to include representation of the operation and settings of any limiters or other controls that may impact on the performance of *reactive power* sources.

2.3.7.3 Long term voltage stability

(a) In assessing the compliance of the *network* with the long term *voltage stability* criteria specified in clause 2.2.11, the *NSP* must first confirm that the *network* can survive the initial disturbance.

(b) The *NSP* must then carry out long term *voltage stability* analysis by a series of *load*-flow simulations of the *transmission system* and, where necessary, the *distribution system* or by using dedicated long-term dynamics software to ensure that adequate *reactive power reserves* are provided within the *network* to meet the long term *voltage stability* criteria in clause 2.2.11, for all credible *generation* patterns and system conditions.

(c) The *NSP* must model the *power system* for long term stability assessment and transfer limit determination purposes, pursuant to subclause 2.3.7.3(b) using the following procedure:

(1) the normal peak *power system generation* pattern, or other credible *generation* pattern determined by operational experience to be more critical, that provides the lowest level of *voltage* support to the area of interest must be assumed. Of the *generating units* normally in service in the area, the *generating unit* that has the largest impact on that area must be assumed to be out-of-service due to a breakdown or other maintenance requirements. If another *generating unit* is assigned as a back-up, that *generating unit* may be assumed to be brought into service to support the *load* area; and

(2) the largest *capacitor bank*, or the reactive device that has the largest impact in the area, must be assumed to be out of-service, where the area involves more than one *substation*.

(3) unless the *power system modelling procedure* provides otherwise, all *loads* must be modelled as *constant P & Q loads*;

(4) the *load* or *power transfer* to be used in the study must be assumed to be 5% higher than the expected system *peak load*, or 5% higher than the maximum expected *power transfer* into the area. (The 5% margin includes a safety margin for hot weather, data uncertainty and uncertainty in the simulation). The *power system voltages* must remain within normal limits with this high *load* or *power transfer*;

(5) the analysis must demonstrate that a positive *reactive power reserve* margin is maintained at major *load* points, and that *power system voltages* remain within the normal operating range for this 5% higher *load*; and

(6) *power system* conditions must be checked after the *outage* and both prior to, and following, tap-changing of *transformers*.

2.3.7.4 Validation of modelling results

The *NSP* must take all reasonable steps to ensure that the results of the simulation and modelling of the *power system* in accordance with the requirements of clauses

2.3.7.1 to 2.3.7.3 and chapter 3 are valid. This may include *power system* and plant performance tests in accordance with clause 4.1.

2.3.8 Determination of power transfer limits

(a) *NSPs* must, on a request by a *controller*, a *generator,* the *ISO* or another *NSP*, determine *power transfer* limits to *equipment* forming part of the *network*. The determined *power transfer* limits must ensure that the system performance criteria specified in clause 2.2 are met and may be lower than the *equipment* thermal ratings.
Further, the determined *power transfer* limits may vary in accordance with different *power system* operating conditions and, consistent with the requirements of these *Rules*, should to the extent practicable maximise the *power transfer* capacity made available to *controllers* (subject to the terms of each *controller's access contract*).

(b) The *power transfer* assessed in accordance with subclause 2.3.8(a) must not exceed 95% of the relevant rotor angle, or other stability limit as may be applicable, whichever is the lowest.

(c) Where the *power transfer* limit assessed in accordance with subclause 2.3.8(a) is determined by the thermal rating of *equipment*, short term thermal ratings should also be determined and applied in accordance with *good electricity industry practice*.

(d) The *NSP*:
   a of a *covered network* — must *publish* the current determined *power transfer limits*;
   b of any other *network* — must notify the determined *power transfer limits* to the *ISO* and to any *NSP* whose network forms part of the same *interconnected Pilbara system*.

{Note: For non-covered networks, any further dissemination will be a matter for private agreement.}

2.3.9 Assessment of power system performance

(a) The *NSP* must monitor the performance of the *power system* on an ongoing basis and ensure that the *networks* are *augmented* as necessary so that the *power system* performance standards specified in clause 2.2 continue to be met irrespective of *changes* in the magnitude and location of *connected loads* and *generating units*.

(b) The *NSP* must ensure that system performance parameter measurements to ensure that the *power system* complies with the performance standards specified in clauses 2.2.1 to 2.2.5 are taken as specified in Table 2.8. Records of all test results must be retained by the *NSP* and made available to the *ISO* on request.

Table 2.8 – Power Quality Parameters Measurement

Parameter	Value measured	*Frequency* of measurement	Minimum measurement period	Data sampling interval
Fundamental *Frequency*	Mean value over interval	Continuous	all the time	10 seconds
Power *frequency voltage* magnitude	Mean RMS value over interval	In response to a complaint, or otherwise as required by the *NSP*.	one week	10 minutes
Short-term flicker severity	P_{st}	In response to a complaint, or otherwise as required by the *NSP*.	one week	10 minutes
Long-term flicker severity	P_{lt}	In response to a complaint, or otherwise as required by the *NSP*.	one week	2 hours
Harmonic / inter-harmonic *voltage* and *voltage* THD	Mean RMS value over interval	In response to a complaint, or otherwise as required by the *NSP*.	one week	10 minutes
Negative sequence *voltage*	Mean RMS value over interval	In response to a complaint, or otherwise as required by the *NSP*.	one week	10 minutes

NOTES:

1. The power quality parameters, except fundamental *frequency* and negative sequence *voltage*, must be measured in each phase of a three-phase system.
2. The fundamental *frequency* must be measured based on line-to neutral *voltage* in one of the phases or line-to-line *voltage* between two phases.
3. Nothing in this clause 2.3.9 limits the information the *NSP* may collect or use in operating its *network* and managing and investigating incidents.

2.4 Under-frequency load shedding and islanding facilities

2.4.1 Under-frequency load shedding schemes

(a) The settings for the under *frequency load shedding* (UFLS) scheme are stated in Table 2.9.

(b) Switchable *capacitor banks* at *substations* must be shed in accordance with Table 2.9.

Table 2.9 – Under-frequency load shedding scheme settings

Stage	*Frequency* (Hz)	Time Delay (sec)	*Stage*	*Load* Shed (%)	Capacitor shed (%)
1	49.00	0.5	UFLS Stage 1	17	35
2	48.75	0.5	UFLS Stage 2	17	
3	48.25	0.5	UFLS Stage 3	17	25
4	48.00	0.5	UFLS Stage 4	17	

2.4.2 Under-frequency islanding schemes

(a) The settings for the *Under Frequency Islanding Scheme (UFIS)* are stated in Table 2.9A.

Table 2.9A – Under-frequency load shedding scheme settings

Stage	*Frequency* (Hz)	Time Delay (sec)	*Stage*	Description
1	48.75	0.5	UFIS Stage 1	Separation of Rio Tinto and Horizon Power Networks at Dampier and Cape Lambert
2	48.50	0.5	UFIS Stage 2	Separation of the network between Cape Lambert and South Hedland Terminal

(b) The Pilbara Grid Under Frequency Islanding Scheme splits the grid into three separate load areas. This is achieved by tripping the following transmission circuits:

a UFIS Stage 1: The 33 kV circuits interconnecting the Rio Tinto and Horizon Power networks at Dampier Main Substation and Cape Lambert Substation.

b UFIS Stage 2: The 220 kV circuit between Cape Lambert and South Hedland Terminal

2.4.3 [not used]

2.4.4 Sequence of UFLS and islanding within the NWIS

(a) This clause 2.4.4 applies in the *NWIS* but not any other *power system*.

(b) When UFLS is required, each *NSP* will implement its own UFLS Stage 1 response within its own network.

(c) If the frequency threshold for UFLS Stage 2 is reached, and a network is:

c not the Horizon Power coastal network; and

d capable of islanding itself safely in accordance with GEIP,

then the *NSP* must island the network in preference to implementing UFLS Stage 2.

(d) If a network is islanded, the *NSP* may manage the under-frequency event as it sees fit in accordance with GEIP within its own network, and clause 2.4.1 does not apply to the network.

(e) While a network is not islanded, it will continue through UFLS Stages 2, 3 and 4 under clause 2.4.1, within its own network.

{Note: The *rules* and the *protocol framework* will deal with de-islanding.}

2.5 Transmission and distribution system planning criteria

(a) In *NSP* must develop, maintain and from time to time review, and may from time to time amend, planning criteria for its network (**"network planning criteria"**).

(b) An NSP's network planning criteria must:

a comply with *GEIP* and these *rules*;

b seek to be consistent with the overall objective of (at least) maintaining *security* and *reliability* within its *network* and across the *power system*;

c for a *covered Pilbara network*:

i be consistent with the *Pilbara electricity objective*; and

ii so far as practicable consistent with the balance of this clause 2.5(b), seek to accommodate access seekers', network users' and *consumers'* reasonable requirements regarding the connection of loads or *generation*.

(c) An *NSP* must give the *ISO* a copy of its *network planning criteria*, and update it promptly after every change.

(d) The *NSP* of a *covered Pilbara network* must *publish* a copy of its *network planning criteria*, and update it promptly after every change.

(e) Not used.

2.6 Transmission and distribution system protection

2.6.1 General requirements

(a) All *primary equipment* on the *transmission* and *distribution system* must be protected so that if an *equipment* fault occurs, the faulted *equipment* item is automatically removed from service by the operation of circuit breakers or fuses. *Protection systems* must be designed, and their settings coordinated, so that, if there is a fault, unnecessary *equipment* damage is avoided and any reduction in *power transfer capability* or in the level of service provided to *controllers* is minimised.

(b) Consistent with the requirement of subclause 2.6.1(a), *protection systems* must remove faulted *equipment* from service in a timely manner and ensure that, where practical, those parts of the *transmission* and *distribution system* not directly affected by a fault remain in service.

(c) *Protection systems* must be designed, installed and maintained in accordance with *good electricity industry practice*. In particular, the *NSP* must ensure that all new *protection apparatus* and all new instrument *transformers* comply with *GEIP*.

2.6.2 Duplication of protection

(a) Transmission System

(1) *Primary equipment* operating at *transmission system voltages* must be protected by a *main protection system* that must remove from service only those items of *primary equipment* directly affected by a fault. The *main protection system* must comprise *two fully independent protection schemes of differing principle*, or if of the same principle, be of a different manufacturer. One of the independent *protection schemes* must include earth fault *protection.*

In order to maintain the integrity of the *fully independent protection schemes*, cross connections between the two schemes shall be avoided. Also, it must be possible to test and maintain either protection scheme without interference with the other.

(2) Primary equipment operating at transmission system voltages must also be protected by a back-up protection system in addition to the main protection system. The back-up protection system must isolate the faulted primary equipment if a small zone fault occurs, or a circuit breaker failure condition occurs.

For *primary equipment* operating at nominal *voltages* of 220 kV and above the *back-up protection system* must comprise *two fully independent protection schemes of differing principle* that must discriminate with other *protection schemes.*

For *primary equipment* operating at nominal *voltages* of less than 220 kV the *back-up protection system* must incorporate at least one *protection scheme* to protect against *small zone faults* or a *circuit breaker failure*.

For *protection* against *small zone faults* there must also be a second *protection scheme* and, where this is co-located with the first *protection scheme*, together they must comprise *two fully independent protection schemes of differing principle*;

(3) The design of the *main protection system* must make it possible to test and maintain either *protection scheme* without interfering with the other; and

(4) *Primary equipment* operating at a *medium voltage* that is below a *transmission system voltage* must be protected by two fully independent *protection systems* in accordance with the requirements of subclause 2.6.2(b)(1).

(b) Distribution System

(1) Each item of *primary equipment* forming part of the *distribution system* must be protected by two independent *protection systems*. One of the independent *protection systems* must be a *main protection system* that must remove from service only the faulted item of *primary equipment*. The other independent *protection system* may be a *back-up protection system*;

(2) Notwithstanding the requirements of subclause 2.6.2(b)(1), where a part of the *distribution system* may potentially form a separate island the *protection system* that provides *protection* against islanding must comprise *two fully independent protection schemes of differing principle* and comply with the requirements of subclause 2.6.2(a)(3).

{Note: When connecting inverter connected generating units of 30 to 150 kVA to the *distribution system* in combination with an IEC 60255 compliant external generator protection relay the installation is exempt from subclause 2.6.2(b)(2). All *protection* functions must comply with GEIP.}

2.6.3 Availability of protection systems

(a) An *NSP* must keep all *protection schemes*, including any back-up or *circuit breaker failure protection scheme*, forming part of a *protection system* protecting part of the *network* operational at all times, except that one *protection scheme* forming part of a *protection system* at a time can be taken out of service for a *prudent period*, for testing and maintenance in accordance with *GEIP*.

(b) If a *protection scheme* forming part of the main or *back-up protection system* protecting a part of the *transmission system* appears likely to be out of service for longer than the *prudent period*, or if the outage might otherwise reasonably be expected to pose a material threat to *security*, the *NSP* must:

a notify the *ISO*;

b return it to service as soon as practicable;

c if necessary in accordance with *GEIP* to preserve *security*, remove the protected part of the *transmission system* from service.

(c) Should either of the two *protection schemes* protecting a part of the *distribution system* be out of service for longer than the *prudent period*, or if the outage might otherwise reasonably be expected to pose a material threat to *security*, the *NSP* must a notify the ISO;

b return it to service as soon as practicable;

c if necessary in accordance with *GEIP* to preserve *security*, remove the protected part of the *distribution system* from service unless the part of the *distribution system* must remain in service to maintain *power system stability*.

(d) In this clause 2.6.3, **“prudent period”** means a period which is prudent in all the circumstances, in accordance with *GEIP*.

2.6.4 Maximum total fault clearance times

(a) This clause 2.6.4 applies to zero impedance short circuit faults of any type on *primary equipment* at nominal system *voltage*. Where *critical fault clearance times* exist, these times may be lower and take precedence over the times stated in this clause 2.6.4. *Critical fault clearance time* requirements are set out in clause 2.6.5.

(b) For *primary equipment* operating at *transmission system voltages*, the maximum *total fault clearance times* in Table 2.10 and Table 2.11 apply to the nominal *voltage* of the circuit breaker that clears a particular fault contribution for both minimum and *maximum system conditions*. For *primary equipment* operating at *distribution system voltages*, the maximum *total fault clearance times* specified for 33 kV and below may be applied to all circuit breakers required to clear a fault for *maximum system conditions*, irrespective of the nominal *voltage* of a circuit breaker.

(c) For *primary equipment* operating at a nominal *voltage* of 220 kV, operation of either *protection scheme* of the *main protection system* must achieve a *total fault clearance time* no greater than the "No CB Fail" time given in Table 2.10. Operation of either *protection scheme* of the *back-up protection system* must achieve a *total fault clearance time* no greater than the "CB Fail" time given in Table 2.10.

(d) For *primary equipment* operating at 132 kV and 66 kV:

(1) one of the *protection schemes* of the *main protection system* must operate to achieve a *total fault clearance time* no greater than the "No CB Fail" time given in Table 2.10. The other *protection scheme* of the *main protection system* must operate to achieve a *total fault clearance time* no greater than the "No CB Fail" time in Table 2.11. The backup *protection system* must achieve a *total fault clearance time* no greater than the "CB Fail" time in Table 2.10, except that the second *protection scheme* that protects against *small zone faults* must achieve a *total fault* clearance *time* no greater than 400 ms;

(2) on 132 kV lines longer than 40 km, all main and back-up *protection schemes* must operate to achieve the relevant maximum *total fault clearance time* given in Table 2.11; and

(3) on 66 kV lines longer than 40 km, one *protection scheme* of the *main protection system* must operate to achieve the *total fault*

clearance times specified for 132 kV in Table 2.11 (rather than the times specified in Table 2.10). The other *protection scheme* of the *main protection system* must operate to achieve the maximum *total fault clearance times* specified for 66 kV in Table 2.11.

(e) For a small zone fault coupled with a circuit breaker failure, maximum total fault clearance times are not defined.

(f) In Table 2.10 and Table 2.11, for *voltages* of 66 kV and above, the term "local end" refers to the circuit breaker(s) of a *protection system* where the fault is located:

(1) within the same *substation* as the circuit breaker;

(2) for a *transmission line* between two *substations*, at or within 50% of the line impedance nearest to the *substation* containing the circuit breaker, provided that the line is terminated at that *substation*;

(3) for a *transmission line* between more than two *substations*, on the same line section as the *substation* containing the circuit breaker, provided that the line is terminated at that *substation*

(g) In Table 2.10 and Table 2.11, for *voltages* of 66 kV and above, the term "remote end" refers to all circuit breakers required to clear a fault, apart from those specified in clause 2.6.4(f).

{Note: Where one or more circuit breakers required to clear a fault are located in a different *substation* from that at which a line is terminated, situations may arise where all circuit breakers required to clear a fault may operate within the remote end *total fault clearance time*.}

(h) In Table 2.10, for *primary equipment* operating at nominal *voltages* of 33 kV and below, the term "local end" refers to the circuit breaker(s) of a *protection system* where the fault is located:

(1) within the same *substation* as the circuit breaker;

(2) for a line between two substations, at or within 50% of the line impedance nearest to the substation containing the circuit breaker, provided that the line is terminated at that substation;

(3) for a line between more than two substations, on the same line section as the substation containing the circuit breaker, provided that the line is terminated at that *substation*

(i) In Table 2.10, for a line operating at nominal *voltages* of 33 kV and below, the term "remote end" refers to all circuit breakers required to clear a fault, apart from those specified in clause 2.6.4(h).

Table 2.10 – Maximum total fault clearance times (ms)

		New *Equipment* No CB Fail	**New *Equipment* CB Fail**
220 kV	Local end	120	430
	Remote end	140	430
132 kV	Local End	120	430
	Remote end	140	430
66 kV	Local End	120	430
	Remote end	140	430
33 kV HP-Rio tie lines	Local End	105	Not specified
	Remote End	105	Not specified
33 kV and below	Local End	300	Not specified
	Remote End	300	Not specified

Table 2.11 – Alternative Maximum total fault clearance times (ms)

		New *Equipment* No CB Fail	**New *Equipment* CB Fail**
132 kV	Local end	120	270
	Remote end	400	565
66 kV	Local end	105	270
	Remote end	400	565

2.6.5 Critical fault clearance times

(a) Notwithstanding the requirements of clause 2.6.4, where necessary to ensure that the *power system* complies with the performance standards specified in clause 2.2, the *NSP* may, and if directed by the ISO must, designate a part of the *network* as subject to a *critical fault clearance time*. The *critical fault clearance time* may be lower than the standard maximum *total fault clearance time* set out in Table 2.10. The *critical fault clearance time* and the *network* configurations to which it applies shall be specified by the *NSP* and notified to the *ISO*.

(b) All *primary equipment* that is subject to a *critical fault clearance time* must be protected by a *main protection system* that meets all relevant requirements of subclause 2.6.2(a). Both *protection schemes* of the *main protection system* must operate within a time no greater than the specified *critical fault clearance time*.

2.6.6 Protection sensitivity

(a) *Protection schemes* must be sufficiently sensitive to detect fault currents in the *primary equipment* taking into account the errors in *protection apparatus* and *primary equipment* parameters under the system conditions in this clause 2.6.6.

(b) For minimum and *maximum system conditions*, all *protection schemes* must detect and discriminate for all *primary equipment* faults within their intended normal operating zones.

(c) For abnormal *equipment* conditions involving two *primary equipment outages*, all *primary equipment* faults must be detected by one *protection scheme* and cleared by a *protection system*. *Back-up protection systems* may be relied on for this purpose. *Fault clearance times* are not defined under these conditions.

2.6.7 Trip supply supervision requirements

Where loss of power *supply* to its secondary circuits would result in *protection scheme* performance being reduced, all *protection scheme* secondary circuits must have *trip supply supervision*.

2.6.8 Trip circuit supervision requirements

All *protection scheme* secondary circuits that include a circuit breaker trip coil have *trip circuit supervision*, which must monitor the trip coil when the circuit breaker is in both the open and closed position and alarm for an unhealthy condition, unless “de-energise to trip” philosophy is employed.

2.6.9 Protection flagging and indication

(a) All protective devices supplied to satisfy the protection requirements must contain such indicating, flagging and event recording that is sufficient to enable the determination, after the fact, of which devices caused a particular trip.

(b) Any failure of the tripping supplies, *protection apparatus* and circuit breaker trip coils must be alarmed, and the *NSP* must put in place operating procedures to ensure that prompt action is taken to remedy such failures.

3 Technical requirements of user facilities

3.1 Introduction

(a) This chapter sets out details of the technical requirements which *controllers* must satisfy as a condition of connection of any *equipment* to the *network* (including *embedded generating units*), except where granted an exemption by the *NSP* in accordance with clause 1.9.1.

(b) The times at which a *controller's facility* may operate will be determined under its access contract, the *Pilbara networks rules* (including any *constraint directions* issued under them) and these *Rules*. An *NSP* and a *controller* may agree additional operating restrictions. In such circumstances the *NSP* and the *controller* may agree, requirements over and above those shown in this chapter, to ensure that the *controller's facility* only operates in accordance with the agreed restrictions. The additional operating restrictions and any additional requirements must be specified in the relevant *access contract*.

(c) The objectives of this chapter are to facilitate maintenance of the *power system* performance standards specified in clause 2.2, so that other *controllers* are not adversely affected, and so that personnel and *equipment* safety are not put at risk following, or as a result of, the connection of a *controller's equipment*.

{Note: The scope of these *Rules* does not include the technical requirements for the provision of *ancillary services* under these *rules* or a commercial arrangement with the *NSP*. *controllers* who provide these *ancillary services* may be required to comply with technical requirements over and above those specified in this chapter. These additional requirements will be specified in the provisions of these *rules* dealing with the *ancillary service* or in the relevant *ancillary services* contract.}

3.2 Requirements for all controllers

3.2.1 Power system performance standards

(a) A *controller* must ensure that each of its facilities *connected* to the *network* is capable of operation while the *power system* is operating within the parameters of the *power system* performance standards set out in clause 2.2.

{Note: The over-*voltage* envelope specified in Figure 2.1 provides for the level of transient over-*voltage* excursions expected on the periphery of the *transmission* and *distribution system*. *controllers* proposing to connect equipment that is intolerant of high c*onnection point voltage* may request the *NSP* to undertake a study to determine the maximum potential over-*voltage* at the proposed *connection point*. The cost of such a study will be the responsibility of the *controller* requesting it.}

(b) Flicker

A *controller* must maintain its contributions to flicker at the *connection point* below the limits allocated by the *NSP* under clause 2.3.3.

(c) Harmonics

(1) A *user* must comply with any harmonic emission limits allocated by the *NSP* under clause 2.3.4(a).

(2) Where no harmonic injection limit has been allocated in accordance with subclause 2.3.4(a), a *controller* must ensure that the injection of harmonics or inter-harmonics from its *equipment* or *facilities* into the *networks* does not cause the maximum system harmonic *voltage* levels set out in Table 2.5 and Table 2.6 to be exceeded at the point of connection.

(d) Negative Phase Sequence Voltage

(1) A *controller connected* to all three phases must balance the current drawn in each phase at its *connection point* so as to achieve 30 minute average levels of negative sequence *voltage* at the *connection point* that are equal to or less than the values set out in Table 2.7.

(e) Electromagnetic Interference

A *controller* must ensure that the electromagnetic interference caused by its *equipment* does not exceed the limits set out in Tables 1 and 2 of *Australian Standard AS* 2344 (1997).

(f) Fault Levels

(1) A *controller connected* to the *transmission system* may not install or connect *equipment* at the *connection point* that is rated for a *maximum fault current* lower than that specified in the *access contract* in accordance with the *network planning criteria*.

(2) A *controller connected* to the *distribution system*, who is not (and is not using the *connection point* to supply) a *small use customer*, must not install *equipment* at the *connection point* that is rated for a *maximum fault current* lower than that specified in the *network planning criteria* unless a lower *maximum fault current* is agreed with the *NSP* and specified in the *access contract.*

{Note: Where a *controller's equipment* increases the fault levels in the *transmission system*, responsibility for the cost of any upgrades to the *equipment* required as a result of the *changed power system* conditions will be dealt with by commercial arrangements between the *NSP* and the *controller*.}

3.2.2 Main switch

A *controller* must be able to de-energise its own *equipment* without reliance on the *NSP*.

3.2.3 Controller's power quality monitoring equipment

(a) An *NSP* may require a *controller* to provide accommodation and connections for the *NSP's* power quality monitoring and recording *equipment* within the *controller's facilities* or at the *connection point*. In such an event the *controller* must meet the reasonable requirements of the

NSP in respect of the installation of the *equipment* and shall provide reasonable access for reading, operating and maintaining this *equipment.*

(b) The inputs that the *NSP* may require a *controller* to provide to the *NSP's* power quality monitoring and recording *equipment* are:

(1) three phase *voltage* and three phase *current* and, where applicable, neutral *voltage* and *current;* and

(2) digital inputs for circuit breaker status and *protection* operate alarms hardwired directly from the appropriate devices. If direct hardwiring is not possible and if the *NSP* agrees, then the *controller* may provide inputs measurable to 1 millisecond resolution and GPS synchronised.

(3) such other inputs as the *NSP* determines are reasonably necessary in accordance with *GEIP*, but for a *covered network* the *NSP* must obtain the *ISO's* approval before making such a determination.

3.2.4 Power system simulation studies

(a) Prior to a controller's facilities being *connected* to the *power system*, the impact on power system performance due to the controller's facilities is to be determined by power system simulation studies as follows:

(1) for a *non-covered network* — the studies are to be as specified by the *NSP*.

(2) for a *covered network* — as determined under the *Pilbara networks rules* and the *Access Code*, or by the *ISO*, and in the absence of any such determination, as specified by the *NSP* acting reasonably, but if so the *NSP* must not, as a pre-condition to granting *access*, specify more studies than is reasonably necessary in accordance with GEIP.

(ab) The studies must be undertaken in accordance with:

(1) the power system modelling procedure; and

(2) subject to clause 3.2.4(ab)(1), the *network modelling procedure*.

(b) The studies may be performed by the *NSP*, the *ISO*, the *controller* or a third party. If studies are performed by a *controller* or by a third party, then:

(1) The *NSP* (and, if the *ISO* is doing any analysis, the *ISO*) must be given full details of the studies performed, including: assumptions made; results; conclusions and recommendations.

(2) If the studies are done by a third party, who is independent and is NER certified, then the *NSP* of a *covered network* must accept the studies, unless doing so would be inconsistent with *GEIP* or the *Pilbara networks rules*. Otherwise, if the studies are done by a person other than the *NSP*, the *covered NSP* must accept the studies, unless there are good reasons not to do so. The *covered*

NSP may consult with the *ISO* on whether the studies should be accepted. For a *non-covered network*, acceptance of the studies will be at the *NSP's* discretion, which is not to be unreasonably withheld.

(3) If the *ISO* is doing any analysis, the ISO's acceptance of studies will be at the *ISO's* discretion, which is not to be unreasonably withheld.

(4) In the absence of fraud or negligence by the accepting *NSP*, acceptance of power system studies by the *NSP* does not absolve a *controller* of responsibility or liability for damages or losses incurred by others.

(c) The *Pilbara networks rules* deal with the final determination on the suitability of a controller's facilities and the requirements to be fulfilled prior to and after the facilities are *connected*.

(d) A *controller* must provide to the *NSP* the following information relating to any of the *controller's facilities connected* or intended to be *connected* to the *transmission system* as is required to enable the undertaking of *power system* simulation studies:

(1) a set of functional block diagrams, including all transfer functions between feedback signals and *generating unit* output;

(2) the parameters of each functional block, including all settings, gains, time *constraints,* delays, dead bands and limits;

(3) the characteristics of non-linear elements; and

(4) Computer models must be in the format specified in the *power system modelling procedure*.

{Note: If the ISO is doing any analysis, the *NSP* will be required by the *Pilbara networks rules* to pass on all information the ISO reasonably requires, which will include information obtained under this clause 3.2.4(d).}

(e) The *NSP* (and, if the *ISO* is doing any analysis, the *ISO*) may provide any information it so receives from a *controller* (**"first user"**) to any other *controller* (**"second user"**) who intends to connect any *equipment* to the *transmission system* (or to the *second user's* technical advisers) for the purposes of enabling the second *controller* (or its technical advisers) to undertake any *power system* simulation studies it wishes to undertake, subject to that *controller* (or those technical advisers) entering into a confidentiality agreement with the *NSP*, to apply for the benefit of the *NSP* , the first *controller* and (if applicable) the *ISO*, in such form as the *NSP* may reasonably require.

3.2.5 Controller's protection systems

3.2.5.1 Overview

(a) For a covered network:

(1) the *NSP* must, if requested by the *applicant*, consult with the *ISO* regarding the *NSP's* functions under this clause 3.2.5; and

(2) the *NSP* must not under this clause 3.2.5 require more *protection equipment* than is reasonably necessary in accordance with GEIP.

(b) The requirements of this clause apply only to a *controller's protection system* that is necessary to maintain *security*. *Protection systems* installed solely to cover risks associated with a *controller's equipment* are at the *controller's* discretion. The extent to which a *controller's equipment* that will need to conform to the requirements of this clause will vary from installation to installation. Consequently, each installation will need to be assessed individually by the *NSP*. Information that may be required by the *NSP* in order to complete this assessment is to be specified under Attachment 5.

(c) The requirement for *protection systems* in respect of any *controller's equipment* that forms an integral part of the *network* (as seen from the *network*) is the same as would apply under clause 2.6 if that *equipment* were the *NSP's equipment*. For the purposes of this clause, a *controller's equipment* forms an integral part of the *transmission* and *distribution system* when the *connection asset* (such as a circuit breaker) that is used to *disconnect* a *controller's equipment* from the *network* is owned by a *controller*.

(d) All *controllers' equipment connected* to the *network* must be protected by *protection systems* or devices that automatically *disconnect* any faulty circuit from the *network*.

(e) A *controller* and the *NSP* must cooperate in the design and implementation of *protection systems*, including with regard to:

(1) the use of *current transformer* and *voltage transformer* secondary circuits (or equivalent) of one party by the *protection system* of the other;

(2) tripping of one party's circuit breakers by a *protection system* of the other party; and

(3) co-ordination of *protection system* settings to ensure inter-operation.

{Note: Any reliance on the *NSP's protection system* to protect an item of *controller's equipment*, and vice versa, including the use of *current transformers and voltage transformers* (or equivalent) and the tripping of circuit breakers, must be agreed between the *NSP* and *user*, and must be included in the relevant *access contract*.}

(f) A *controller's protection systems* must be located on the relevant *controller's equipment* and must discriminate with the *NSP's protection systems* and that of other *controllers*.

(g) Except in an emergency, a *controller* with *equipment connected* directly to the *transmission system* must notify the *NSP* at least 5 *business days* prior to taking out of service all or part of a *protection system* of any *equipment* operating at a nominal *voltage* of 66 kV or greater.

(h) The installation and use of *automatic reclose equipment* in a *consumer's facility* are permitted only with the prior written agreement of the *NSP*, which must not be unreasonably delayed, withheld or conditioned.

(i) A *consumer* must not adjust its *protection* settings without the *NSP's* approval.

3.2.5.2 Specific protection requirements for generators' facilities

(a) The requirements of this clause do not apply to a *generation facility* where the total rating of all *generating units* in that generating *facility* is less than 10 MW and which are *connected* to the *distribution system* at a nominal *voltage* below 66 kV. For that case, the *protection system* requirements are specified in clauses 3.4 and 3.5.

(b) The *protection system* for a *generating unit* must be designed to protect the *generating unit* from faults on the *network* and to minimise damage to the *generating unit* from in-feeds from the *transmission* and *distribution system* in the event of an internal fault. The *main protection system* must incorporate *two fully independent protection schemes of differing principle*, each discriminating with the *transmission* and *distribution system*. Where a *critical fault clearance time* exists, each *protection scheme* must be capable of operating to achieve the *critical fault clearance time*. Where there is no *critical fault clearance time* both independent *protection schemes* must meet the relevant maximum *total fault clearance times* specified in clause 2.6.4.

(c) The design of the *two fully independent protection schemes of differing principle* must make it possible to test and maintain either *protection scheme* without interfering with the other.

(d) The *generator's protection system* and other controls must achieve the following functions:

(1) *disconnection* of the *generator's generating unit* from the *network* if any of the *protection schemes* required by subclause 3.2.5.2 (b) operate;

(2) separation of the *generator's generating unit* from the *network* if there is a loss of *supply* to the *controller's* installation from the *network*;

(3) prevention of the *generator's generating unit* from energising de-energised *NSP equipment*, or energising and *supplying* an otherwise isolated portion of the *network* except where a

generator is *directed* under the *Pilbara networks rules* to provide a black start *ancillary service*;

(4) adequate protection of the *generator's equipment* without reliance on back up from the *NSP's protection apparatus* except as agreed with the *NSP* in accordance with subclause 3.2.5.1(d); and

(5) detection of a failure of a *generator's* circuit breaker to clear a fault due to either mechanical or electrical failure. If such a failure is detected, the *generator's protection system* must send a trip signal to an alternative circuit breaker, which may be provided by the *NSP* in accordance with subclause 3.2.5.1(d), in order to clear the fault.

(e) A *generator* must install check synchronising interlocks on all of its circuit breakers that are capable of out-of-*synchronism* closure, unless otherwise interlocked as agreed between the *generator* and the *NSP*.

(f) If a *generating unit* is *connected* to the *distribution system,* the *generator* must provide a circuit breaker close inhibit interlock with the feeder circuit breaker at the *NSP's substation* in accordance with the requirements agreed between the *generator* and the *NSP* in accordance with *GEIP*.

{Note: This interlock is required in addition to the islanding *protection* specified in subclause 3.2.5.2(d) (3) on account of the potential safety hazard if a deenergised *distribution feeder* was energised by an *embedded generating unit*.}

3.2.5.3 Specific protection requirements for consumer facilities

(a) A *consumer* must provide a *main protection system* to *disconnect* from the *power system* any faulted element within its protection zone within the *total fault clearance time* agreed with the *NSP* and specified in the relevant *access contract*. For *equipment* supplied from *connection points* with a nominal *voltage* of 33 kV or greater, the *total fault clearance times* are the relevant times specified in clause 2.6.4 unless a *critical fault clearance time* applies in accordance with clause 2.6.5, in which case the required *total fault clearance time* is the *critical fault clearance time*.

(b) If the *consumer's connection point* has a nominal *voltage* of 66 kV or greater, the *main protection system* must:

(1) have sufficient redundancy to ensure that a faulted element is *disconnected* from the *power system* within the applicable *fault clearance time* as determined in accordance with subclause 3.2.5.3(a) with any single *protection* element (including any communications *facility* upon which the *protection system* depends) out of service;

(2) provide a circuit breaker failure protection scheme to clear faults that are not cleared by the circuit breakers controlled by the primary protection system within the applicable fault clearance time as determined in accordance with subclause 3.2.5.3(a). If a circuit breaker fails, the *consumer's* protection system may send a trip signal to a circuit breaker provided by the *NSP* in accordance with subclause 3.2.5.1(d), in order to clear the fault.

3.2.6 Technical matters to be coordinated

(a) Subject to these *rules* and all other applicable laws, the *generator* and the *NSP* must agree upon the following matters in respect of each new or altered connection:

(1) design at connection point;

(2) physical layout adjacent to *connection point*;

(3) back-up (alternative) *supply* arrangements;

(4) *protection* and back-up;

(5) control characteristics;

(6) communications, metered quantities and alarms;

(7) insulation co-ordination and lightning *protection*;

(8) fault levels and fault clearing times;

(9) switching and isolation facilities;

(10) interlocking arrangements;

(11) synchronising facilities;

(12) under *frequency load shedding* and islanding schemes; and

(13) any special test requirements.

(b) As an alternative to *distribution system augmentation*, the *NSP* and *generator* may agree that the *generator* is to provide additional *protection schemes* to ensure that operating limits and agreed import and export limits are not exceeded.

3.3 Requirements for connection of generating units > 10 MW

3.3.1 General

(a) A *generator* must comply at all times with applicable requirements and conditions of connection for *generating units* as set out in this clause.

(b) A *generator* must operate facilities and *equipment* in accordance with any and all *directions* given by the *NSP* under these *Rules* or under any *written law*. For a *covered network,* the *NSP* must not give a direction in excess of what is reasonably necessary in accordance with GEIP.

(c) For *generating units* the combined rating of which is less than 10 MW and which is *connected* to the *distribution system*, the connection requirements of clause 3.4 or clause 3.5 apply. This clause 3.3 applies to *generating units* the combined rating of which is 10 MW or greater.

{NOTE: The 10 MW threshold, is chosen due to the need to treat higher capacity *generators* separately as to their requirements with respect to this clause"

(d) EEA *generating unit* must have *equipment* characteristics and *control systems*, including the inertia (effective, presented to the *power system*), short-circuit ratio and *power system* stabilisers, sufficient not to cause any reduction of *power transfer capability* because of:

(1) reduced rotor angle stability;

(2) reduced *frequency stability*; or

(3) reduced *voltage stability,* relative to the level that would apply if the *generating unit* were not *connected.*

{Note: The effect of this clause is to prevent *generating units* being permitted to connect to the *network* if, as a result of the connection of the *generator* in accordance with the relevant *access contract* and any *constraint rules* the power transfer capability of the *power system* will be reduced.}

(e) An unplanned trip of a *generating unit* must not cause an increased need for *load shedding* (other than any load which may be shed as a result of inter-trip arrangements in the *generator's* own *access contract* or under a *constraint rule*) because of:

(1) rate of change of frequency;

(2) magnitude of *frequency* excursion;

(3) *active power* imbalance;

(4) *reactive power* imbalance; or

(5) displacement of reactive capability,

over and above the level that would apply if the *generating unit* was not *connected*.

{Note: The effect of this clause is to limit the maximum *generating unit* size that is permitted to connect to the *network* without taking appropriate action to rectify the potential problem or agree suitable terms for constrained access.}

(f) A *generator* must ensure that its transients do not adversely affect the *NSP* and other controllers.

(g) Unless otherwise specified in these *Rules*, the technical requirements for *generating units* apply at the *connection point*.

(h) A *generating unit* must *disconnect* from the *distribution system* if the *distribution feeder* to which it is *connected* is separated from the remainder of the *power system*.

3.3.2 Provision of information

(a) Subject to clause 3.3.2(b), a *generator* must provide all data in relation to the design, construction, operation and configuration of the *generating unit* as is reasonably required by the *NSP* to assess the impact of the *generating unit* on the *reliability* and *security* of the *network*.

{Note: If the ISO is doing any analysis, the *NSP* will be required by the *Pilbara networks rules* to pass on all information the ISO reasonably requires, which will include information obtained under this clause 3.3.2.}

(b) For a covered network:

a the *NSP* must not under this clause 3.3.2 require more information than is reasonably necessary in accordance with *GEIP* to enable the *NSP* to assess the application and make an access offer; and

b the *controller Access Guide* published under the *PNAC* must set out clearly the information the *NSP* is likely to require under this clause 3.3.2.

{Note: For a non-covered network, the *NSP* may determine from time to time what information it requires.}

3.3.3 Detailed technical requirements requiring ongoing verification

A *generator* must verify compliance of its own *equipment* with the technical requirements of this clause by the methods described in clause 4.1.3.

3.3.3.1 Reactive power capability

(a) Each *generating unit*, and the *power station* in which the *generating unit* is located, must be capable of continuously providing its full *reactive power* output required under this clause within the full range of steady state *voltages* at the *connection point* permitted under clause 2.2.2.

{Note: This requirement must be met for all operating conditions, including ambient temperature. Unless operating restrictions have been agreed in accordance with subclause 3.1(b), the NSP may assume the site specific maximum ambient temperature shown in the figure below when assessing compliance with the requirements of this clause.}

(b) Each *generating unit* must include a *control system* that is capable of varying the *reactive power* at the *connection point* between the maximum import level and maximum export level required by this clause. This control must be continuous to the extent that it must not depend on mechanically switched devices other than an on-*load* tap changer forming part of the *generating unit transformer*.

{Note: The *control system* must also meet the relevant performance requirements of clause 3.3.4.5.

(c) Therefore:

(1) Each *synchronous generating unit*, while operating at any level of *active power* output between its maximum and minimum *active power* output level as notified to the *NSP*, must be capable of:

(A) *supplying* at its *generator machine's* terminals an amount of *reactive power* of at least the amount equal to the product of the rated *active power* output of the *generating unit* at nominal *voltage* and 0.750; and

(B) absorbing at its *generator machine's* terminals an amount of *reactive power* of at least the amount equal to the product of the rated *active power* output of the *generating unit* at nominal *voltage* and 0.484.

Refer to Figure 3.1 for details.

{Note: This clause requires a *generator machine*, when producing its notified maximum *active power* output, to be capable of operating at any *power factor* between 0.8 lagging and 0.9 leading.}

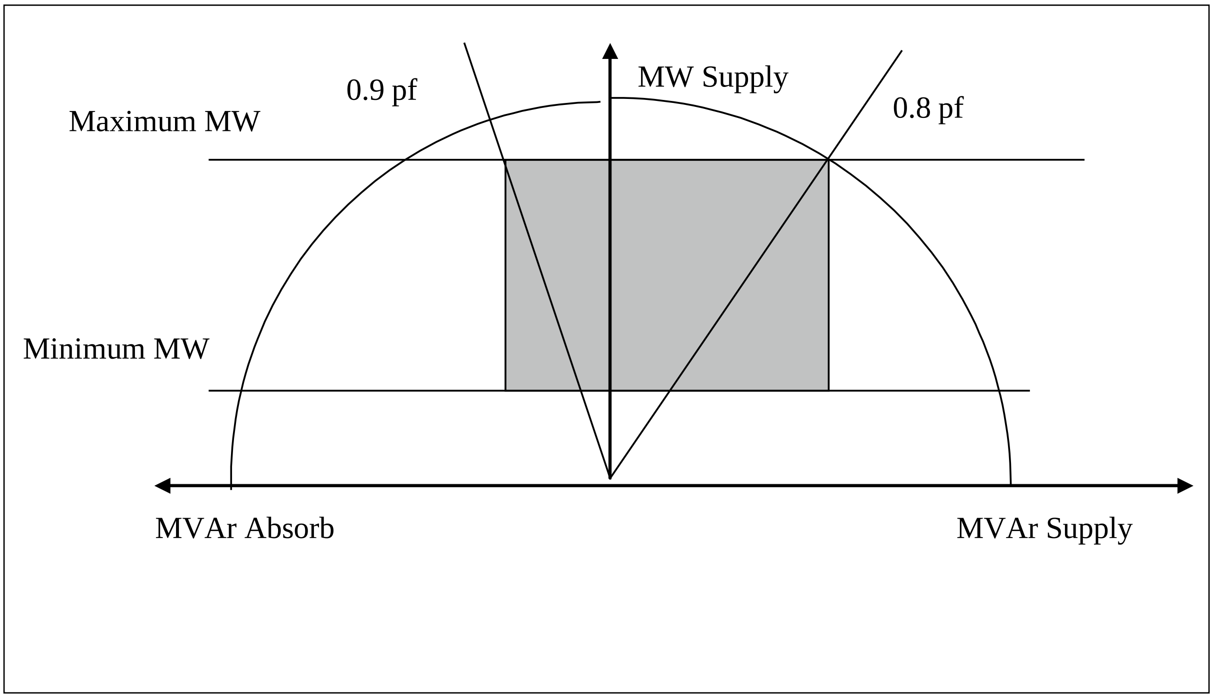

Figure 3.1 – Synchronous generating unit. Minimum reactive power capability requirements at generator machine terminals shown shaded

(2) Each *induction generating unit*, while operating at any level of *active power* output between its notified maximum and minimum output level, must be capable of *supplying* or absorbing an amount of *reactive power* at the *connection point* of at least the amount equal to the product of the rated *active power* output of the *generating unit* at nominal *voltage* and 0.329. Refer to Figure 3.2 for details.

{Note: This clause requires an *induction generating unit*, when producing its notified maximum *active power output*, to be capable of operating at any *power factor* between 0.95 lagging and 0.95 leading.}

(3) Where necessary to meet the performance standards specified in clause 2.2, the *NSP* and the *generator* may agree that an *induction generating unit* is to be capable of *supplying* or absorbing a greater amount of *reactive power* output than specified in subclause 3.3.3.1(c)(2). The need for such a requirement will be determined by *power system* simulation

studies and any such a requirement must be included in the *access contract*.

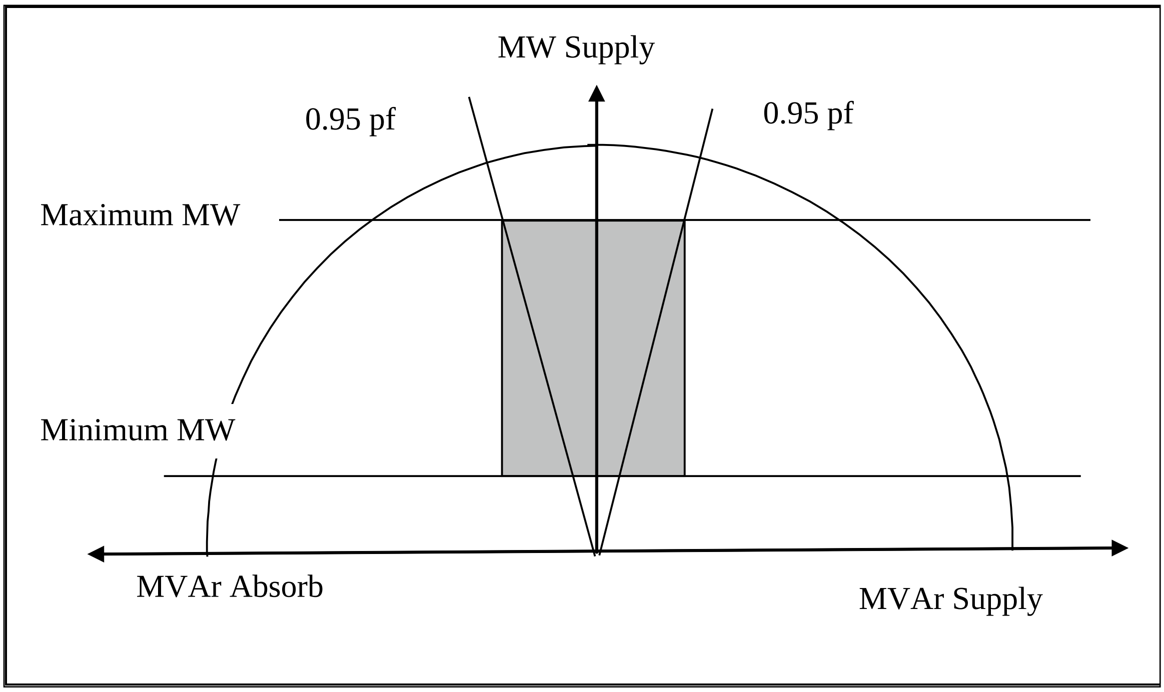

Figure 3.2 – Induction generating unit. Minimum reactive capability requirements at connection point shown shaded

(4) Each *inverter coupled generating unit* or *converter coupled generating unit*, while operating at any level of *active power* output between its notified maximum and minimum output level, must be capable of *supplying reactive power* such that at the inverter or converter *connection point* the lagging *power factor* is less than or equal to 0.95 and must be capable of absorbing *reactive power* at a leading *power factor* less than or equal to 0.95. Refer to Figure 3.3 for details.

(5) Where necessary to meet the requirements of these *Rules*, the *NSP* and the *generator* may agree that an inverter *generating unit* is to be capable of *supplying* a *reactive power* output coincident with rated *active power* output over a larger *power factor* range. The need for such a requirement be determined by *power system* simulation studies and any such a requirement must be included in the *access contract*.

(d) For *generating units* not described by subclause 3.3.3.1(c), the *power factor* requirements must be as agreed between the *NSP* and the *generator* and included in the *access contract*. In determining the appropriate *power factor* requirement, the *NSP* and *generator* and, if applicable, the *ISO* must consider the intrinsic capabilities of such a new technology and the potential for its penetration.

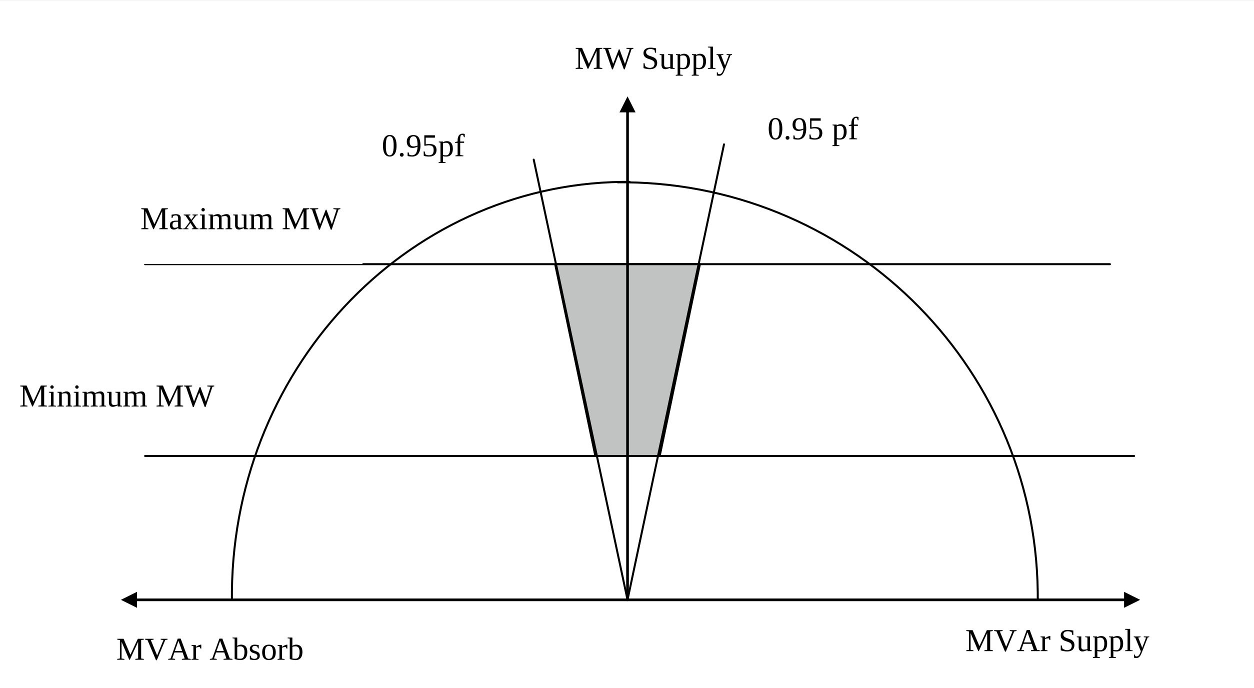

Figure 3.3 – Inverter coupled generating unit or converter coupled generating unit. Minimum reactive capability requirements at connection point shown shaded

(e) If the *power factor* capabilities specified in subclause 3.3.3.1(c) cannot be provided by the *generator machine*, the *generator* must provide the required capacity by including an additional source of *reactive power* within the *facility*. The *control system* for the additional source of *reactive power* must be coordinated with that of the main *generator* and, together, they must meet the performance requirements of clause 3.3.4.5.

{Note: This subclause 3.3.3.1(e) is intended to facilitate flexibility in design by assisting proponents to connect *generating units* that, of themselves, are not capable of meeting the *reactive power generation* requirements specified in clause 3.3.3.1 through providing for the shortfall to be made up through some other means such as *static VAr compensators*, *static synchronous compensators,* inverters, thyristor switched *capacitor banks* and thyristor switched *reactors.}*

(f) If the *voltage* at the *connection point* falls below the steady state level permitted by clause 2.2.2, the output current of the *facility* must not be less than the output current of the *facility* if it was providing the maximum *reactive power* required by this clause 3.3.3.1 when generating its maximum rated *active power* with the *connection point* at nominal *voltage*.

(g) The *NSP* and *generator* may agree that the *generator* is required to achieve full compliance with the requirements of this clause 3.3.3.1 in return for a capital contribution towards the provision of new sources of *reactive power* within the *transmission* or distribution *network*. The basis for determining the required capital contribution must be the additional capital cost that the proponent would reasonably be expected to incur if full compliance with the requirements of this clause was not waived.

(h) Each *generating unit's* connection must be designed to permit the *dispatch* of the full *active power* and *reactive power capability* of the *facility*.

3.3.3.2 Generating unit performance standard

A *synchronous generating unit* or an *induction generating unit* must be designed to *generate* a constant *voltage* level with balanced phase *voltages* and harmonic *voltage* distortion equal to or less than permitted in accordance with either *Australian Standard AS* 1359 (1997) "General Requirements for Rotating Electrical Machines" or a recognised equivalent international standard as agreed between the *NSP* and the *controller* if the *generating unit* was not *connected* to the *network.*

3.3.3.3 Generating unit response to disturbances in the power system

(a) **Overview**

The following are design requirements for *generating units* and their auxiliary systems for continuous uninterrupted operation while being subjected to off-nominal *frequency* and *voltage* excursions. Continuous uninterrupted operation is defined in subclause 3.3.3.3(h).

{Note: Some of these requirements may be relaxed when it is considered that failure to comply would not have a material impact on safety or *power system* performance. A *generator* seeking a relaxation of the requirements must apply for an exemption from the *Rules.*}

(b) **Immunity to frequency excursions**

A *generating unit* and a *power station* in which the *generating unit* is located must be capable of continuous uninterrupted operation within the *power system frequency* envelope specified in Figure 3.4. Operation for a period of at least 20 seconds is required each time the *frequency* is below 47.5 Hz. Operation for a period of at least 6 seconds is required each time the *frequency* is above 52 Hz. Below 47 Hz and above 52.5 Hz, instantaneous *disconnection* of *generating units* is permitted.

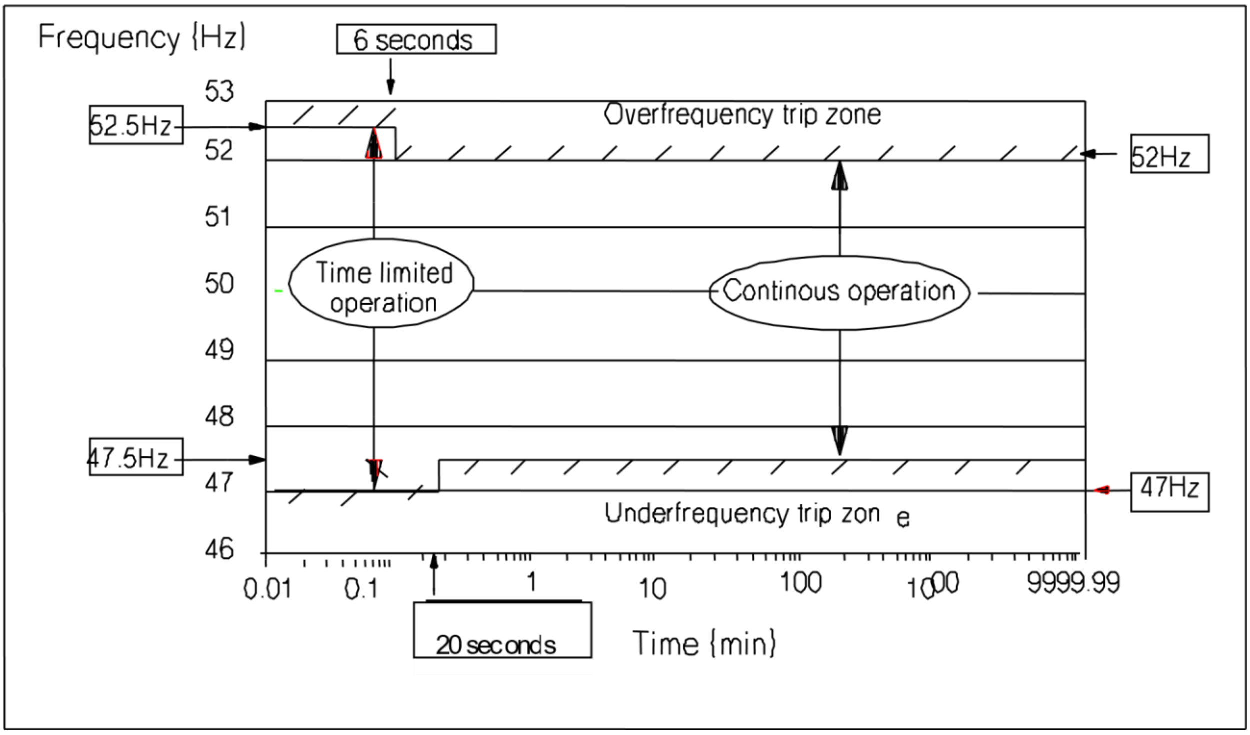

Figure 3.4 – Off nominal frequency operation capability requirement for generating units

{Note:

1. The requirements of Figure 3.4 provide a safety margin relative to the *frequency operating standards* of Table 2.1, within which a *generator* may apply for an exemption from compliance from these *Rules.*

2. These requirements must be met for all operating conditions, including ambient temperature. Unless operating restrictions have been agreed in accordance with subclause 3.1(b) the *NSP* may assume the site specific maximum ambient temperature indicated in subclause 3.3.3.1(a) when assessing compliance with the requirements of this clause.

(c) **Immunity to voltage excursions**

(1) A *generating unit* and the *power station* in which the *generating unit* is located must be capable of continuous uninterrupted operation for *network* faults which cause the *voltage* at the *connection point* to drop below the nominal *voltage* for a period equal to the *circuit breaker failure* fault clearing time to clear the fault plus a safety margin of 30 ms, followed by a period of 10 seconds where the *voltage* may vary in the range 80% to 110% of the nominal *voltage,* and a subsequent return of the *voltage* within the range 90 to 110% of the nominal *voltage.*

(2) Notwithstanding the requirements of subclause 3.3.3.3(c)(1) no *generating unit* shall be required to be capable of continuous uninterrupted operation where the *voltage* at the *connection point* falls below the envelope shown in Figure 3.5.

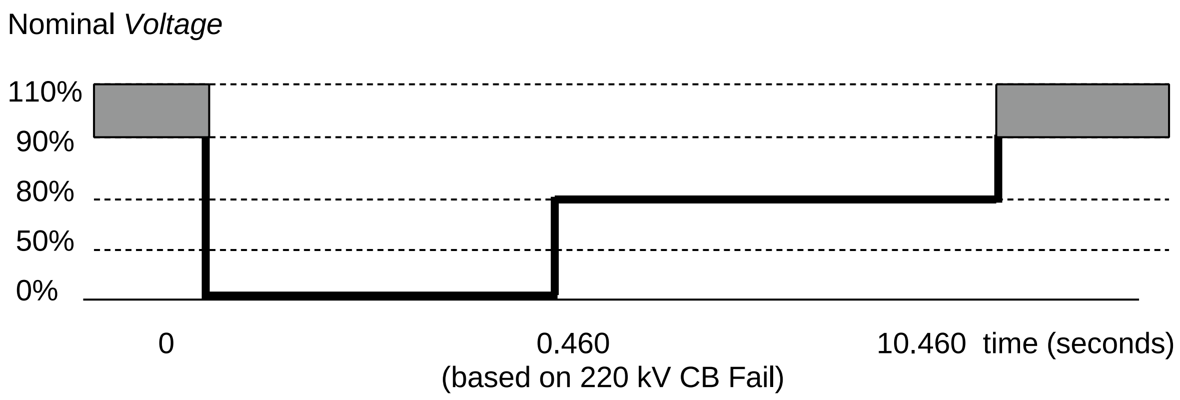

Figure 3.5 – Off nominal *voltage* operation capability requirement for *generating units*.

(d) **Immunity to rate-of-change of frequency**

A *generating unit* and the *power station* in which the *generating unit* is located must be capable of continuous uninterrupted operation for any rate-of-*change*-of-*frequency* of up to 4 Hz per second.

(e) **Immunity to high speed auto reclosing**

A *generating unit* and the *power station* in which the *generating unit* is located must be capable of continuous uninterrupted operation for *voltage* transients caused by high speed auto-reclosing of *transmission lines* irrespective of whether or not a fault is cleared during a reclosing sequence.

See Figure 3.6 for details of the *low voltage* ride through requirement during auto-reclose operation.

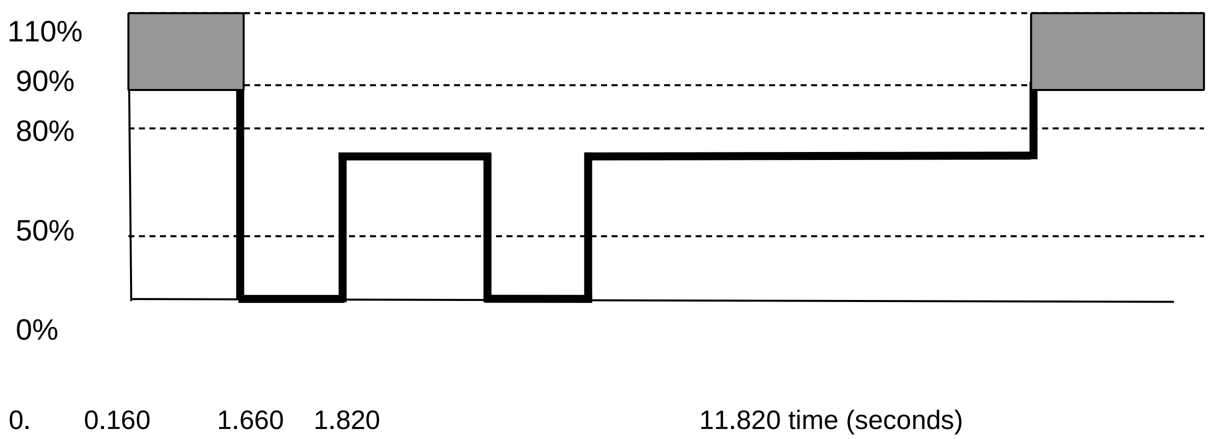

Figure 3.6 – Off nominal *voltage* operation capability requirement for *generating units* during auto-reclose operation

(f) **Post-fault reactive power of a power station with non-synchronous generating units**

After fault clearing, the *power station* in which a non-*synchronous generating unit* is located must not absorb *reactive power* from the *transmission system* or the *distribution system*. Any pre-fault absorption of *reactive power* has to be terminated within 200 ms after clearing of the fault. The absorption is permitted to recommence, if required by the applicable *voltage* control strategy, after the postfault *voltages* stabilise for at least 60 seconds at an above nominal value.

{Note: This requirement is intended for under-*voltage* situations where a *generator* is potentially exacerbating the problem.}

(g) **Post fault voltage control of a connection point**

Each *generating unit* must be fitted an *active power* output *controller*, such as a governor, and a *voltage* regulator so that, following the occurrence of any *credible contingency event* and *changed power system* conditions after *disconnection* of the faulted element, the *generating unit* must be capable of delivering to the *network active power* and *reactive power* sufficient to ensure that the *connection point voltage* is within the range for continuous uninterrupted operation for that *generating unit*.

(h) **Continuous uninterrupted operation**

For the purposes of this clause, a *generating unit* is considered to remain in continuous uninterrupted operation if:

(1) the generating unit is not disconnected from the network due to protection system operation;

(2) the *active power* output returns to the *generating unit's* pre-fault electric power output within 200 milliseconds after the *voltage* has returned to between 80% to 110% of nominal *voltage*. In making this assessment allowances may be made for:

(A) any variation in *active power* output for non-*synchronous generating units* due to variation in the primary source of *energy*; and

(B) any variation in *active power* output of *synchronous generating units* due to any reduction in the *power system frequency* in accordance with the capability of the *generating unit* as notified to the *NSP*.

(3) the *reactive power* control mode in which the *generating unit* was operating prior to the *credible contingency event* occurring does not *change*, unless it is required by subclause 3.3.3.3(f).

3.3.3.4 Sudden reduction in active power requirement

A *generating unit* must be capable of continuous uninterrupted operation as defined in subclause 3.3.3.3(h) during and following a sudden reduction in required *active power generation* imposed from the *power system,* provided that the reduction is less than 30% of the *generator machine's nameplate rating* and the required *active power generation* remains above the *generating unit's* notified minimum *active power generation* capability.

3.3.3.5 Ramping rates

(a) A *dispatchable generating unit*, in a thermally stable state, must be capable of increasing or decreasing *active power generation* in response to a manually or remotely initiated order to *change* the level of *generated active power* at a rate not less than 5% of the *generator machine's nameplate rating* per minute.

(b) A non-*dispatchable generating unit* must not increase or decrease its *active power generation* at a rate greater than 15% of the *generator machine's nameplate rating* per minute.

3.3.3.6 Safe shutdown without external electricity supply

A *generating unit* must be capable of being safely shut down without an electricity *supply* being available from the *network* at the relevant *connection point*.

3.3.3.7 Restart following restoration of external electricity supply

(a) A *generating unit* must be capable of being restarted and synchronised to the *network* without unreasonable delay following restoration of external *supply* from the *network* at the relevant *connection point*, after being without external *supply* for 2 hours or less, provided that the *generating unit* was not *disconnected* due to an internal fault.

{Note: Examples of unreasonable delay in the restart of a *generating unit* are:

1. delays not inherent in the design of the relevant start-up *facilities* and which could reasonably have been eliminated by the relevant *generator*; and

2. minimise start up time delays for the *generating unit* following loss of external supplies for 2 hours or less and which could reasonably have been eliminated by the relevant *generator*.

(b) The maximum restart time, agreed by the *generator* and the *NSP*, must be specified in the relevant *access contract*.

3.3.3.8 Protection of generating units from power system disturbances

(a) A *generating unit* may be *disconnected* automatically from the *network* in response to abnormal conditions arising from the behaviour of the *power system*. However, a *generating unit* must not be *disconnected* if the *power system* conditions at the *connection point* remain within the envelope described in clause 3.3.3.3 for continuous uninterrupted operation.

(b) The abnormal conditions referred to in clause 3.3.3.8(a) are to be agreed between the *generator* and the *NSP*, and may include:

(1) loss of synchronism;

(2) high or low *frequency* outside the *generator* off-nominal *frequency* operation capability requirements specified in Figure 3.4;

(3) sustained excessive *generating unit* stator current that cannot be automatically controlled;

(4) high or low stator *voltage* outside *generator machine* rating;

(5) *voltage* to *frequency* ratio outside *generator machine* rating;

(6) negative phase sequence current outside *generator machine* rating; and

(7) any similar condition agreed between the *generator* and the *NSP*.

(c) The actual design and settings of the *protection equipment* installed in order to *disconnect* a *generating unit* in accordance with subclause 3.3.3.8(a) must be consistent with *power system* performance requirements specified in subclause 3.3.3.8(a) and must be approved by the *NSP*.

3.3.3.9 Generating unit step-up transformer

(a) **Transformer impedance:**

The maximum permitted impedance of a *generating unit step-up transformer* is 15% of the *generator's* MVA rating.

(b) **Vector group:**

generating unit transformer's vector group must be agreed with the *NSP.* The vector group must be compatible with the *power system* at the *connection point* and preference may be given to vector groups with a zero sequence opening between *high voltage (or medium voltage)* and *low voltage* windings.

(c) **Tap changing:**

generating unit transformer of a *generating unit* or *wind farm* must be capable of on-*load* tap-changing within the range specified in the relevant *access contract*.

3.3.4 Monitoring and control requirements

3.3.4.1 Remote monitoring

(a) The *NSP* may by notice require a *controller* to:

(1) provide *remote monitoring equipment* (RME) to enable the *NSP* to monitor performance of a *generating unit connected* to its *network* (including its *dynamic performance*) remotely where this is necessary in real time for control, planning or *security* of the *power system*; and

(2) upgrade, modify or replace any RME already installed in a *power station connected* to its *network* provided that the existing RME is no longer fit for purpose in accordance with *GEIP* and notice is given in writing to the relevant *generator* accordingly.

(b) The *ISO* may at any time by notice to the *NSP*, require the *NSP* to issue and implement a notice to a *controller* under clause 3.3.4.1(a), if the *ISO* considers that:

(1) the provision of particular RME is necessary or reasonably desirable to maintain or improve *security*; and

(2) the *NSP* is not adequately managing the need for the RME.

(c) Any RME provided, upgraded, modified or replaced (as applicable) under this clause 3.3.4.1, must conform to an acceptable standard as agreed between the *NSP* and the *controller* and must be compatible with the *NSP's SCADA system*.

(d) Input information to RME may include the following:

(1) Status Indications

(A) generating unit circuit breaker open/closed (dual point);

(B) remote *generation load* control on/off;

(C) *generating unit* operating mode;

(D) turbine control limiting operation; and

(E) connection to the *network* (may include isolation, earthing, power flow direction, voltage etc.);

(2) Alarms

(A) generating unit circuit breaker / main switch tripped by protection; (B) prepare to off load; and

(B) *protection* defective alarms;

(3) Measured Values

(A) *transmission system*:

(i) gross *active power* output of each *generating unit;*

(ii) gross *reactive power* output of each *generating unit;*

(iii) station *active power* import or export at each *connection point;*

(iv) net station *reactive power* import or export at each *connection point;*

(v) *generating unit* stator *voltage;*

(vi) *generating unit transformer tap position*;

(vii) net station output of *active energy* (impulse);

(viii) *generating unit* remote *generation* control high limit value;

(ix) *generating unit* remote *generation control* low limit value; and

(x) *generating unit* remote *generation* control rate limit value.

(B) *distribution system*:

(i) main switch *active power* import or export;

(ii) main switch *reactive power* import or export;

(iii) *voltage* on the *NSP* side of main switch; and

(iv) *such other input information reasonably required by the NSP.*

3.3.4.2 Remote control

(a) The *NSP* may, for any *generating unit* which may be unattended when *connected* to the *network*, require the *generator* to:

(1) provide *remote control equipment (RCE)* to enable the *NSP* to *disconnect* a *generating unit* from the *network*; and

(2) upgrade, modify or replace any *RCE* already installed in a *power station* provided that the existing *RCE* is, in the opinion of the *NSP*, no longer fit for purpose and notice is given in writing to the relevant *controller* accordingly.

(b) Any *RCE* provided, upgraded, modified or replaced (as applicable) under clause (a) must conform to an acceptable standard as agreed by the *NSP* and must be compatible with the *NSP's SCADA system*, including the requirements of clause 5.10.

3.3.4.3 Communications equipment

(a) A *generator* must provide communications paths (with appropriate redundancy) between the *RME* and *RCE* installed at any of its *generating units* to a communications interface at the relevant *power station* and in a location acceptable to the *NSP*. For connections to *distribution system*, this nominated location is in the *zone substation* from which the *distribution feeder* to which the *controller* is *connected* emanates. Communications systems between this communications interface and the relevant *control centre* are the responsibility of the *NSP,* unless otherwise agreed.

(b) Telecommunications between the *NSP* and *generators* must be established in accordance with the requirements set out below for *operational communications.*

(c) Primary Speech Communication Channel

(1) A *generator* must provide and maintain a speech communication channel by means of which routine and emergency control telephone calls may be established between the *generator*'s responsible engineer or the person responsible for operating the *generating works* in real time, and the *NSP* and the *ISO*.

(2) The speech communication channel provided must meet the reasonable requirements advised by the *NSP* and the *ISO.*

(3) Where the public switched telephone network is to be used as the primary speech communication channel, a sole-purpose connection, which must be used only for *operational communication*s, must be provided.

(d) Back-up Speech Communications Channel

(1) The *NSP* must provide a separate telephone link or other back-up speech communications channel for the primary speech communications channel.

(2) The *NSP* must be responsible for planning installing and maintaining the back-up speech communications channel, and for obtaining radio licenses if required.

(3) The *NSP* may recover the cost of providing the backup speech communications channel from the *generator* as agreed in the relevant *access contract.*

3.3.4.4 Frequency control

(a) All *generating units* must have an automatic variable speed control characteristic. *Turbine control systems* must include *facilities* for both *frequency* and *load control.*

(b) *Generating units* must be capable of *operation* in a mode in which they will automatically and accurately alter *active power* output to allow for *changes* in associated *load*s and for *changes* in *frequency* of *the transmission and distribution system* and in a manner to sustain high initial response.

(c) A *generator* must, operate a *generating unit* in the mode specified in subclause (b) unless instructed otherwise by the *NSP* or the *ISO*, as the case requires.

(d) **Dead band**

The dead band of a *generating unit* (the sum of increase and decrease in *power system frequency* before a measurable *change* in the *generating unit*'*s active power* output occurs) must be less than 0.05 Hz, unless an adjustable dead band is agreed to in the *access contract*.

(e) **Control range**

(1) For dispatchable generating units:

(A) The overall response of a *synchronous generating unit* for *power system frequency* excursions must be settable and be capable of achieving an increase in the *generating unit's active power* output of not less than 5% for a 0.1 Hz reduction in *power system frequency* (4% droop) for any initial output up to 85% of rated output.

(B) A *synchronous generating unit* must also be capable of achieving a reduction in the *generating unit's active power* output of not less than 5% for a 0.1 Hz increase in system *frequency* provided this does not require operation below the *technical minimum*.

(C) For initial outputs above 85% of rated *active power* output, a *generating unit's* response capability must be included in the relevant *access contract*, and the *generator* must ensure that the *generating unit* responds in accordance with that *access contract*.

(D) *Thermal generating units* must be able to sustain *load changes* of at least 10% for a *frequency* decrease and 30% for a *frequency* increase if *changes* occur within the above limits of output.

(2) For *non-dispatchable generating units, a generating unit* must be capable of achieving a reduction the *generating unit*'*s active power* output for an increase in system *frequency,* provided the latter does not require operation below *technical minimum*.

(f) **Rate of response**

(1) For *dispatchable generating units*, for any *frequency* disturbance, the *generating unit* must achieve at least 90% of the maximum response expected according to the droop characteristic within 6 seconds for *thermal generating units* or 30 seconds for hydro *generating units* and the new output must be sustained for not less than a further 10 seconds.

(2) For *non-dispatchable generating units*, for any *frequency* disturbance, a *generating unit* must achieve at least 90% of the maximum response expected within 2 seconds and the new output must be sustained for not less than a further 10 seconds.

3.3.4.5 Voltage control system

{Note: The overriding objective of a *generating unit's voltage control system* is to maintain the specified *voltage* range at the *connection point*.

(a) The excitation control system of a synchronous generating unit must be capable of:

(1) limiting the *reactive power* absorbed or supplied by the *generating unit* to within *generating unit's* capability for continuous operation given its *load le*vel;

(2) controlling the *generating unit's* excitation to maintain the short-time average *generating unit* stator *voltage* below its highest rated level (which must be at least 5% above the nominal stator *voltage*);

(3) maintaining adequate *generating unit* stability under all operating conditions and *providing power system* stabilising action if fitted with a *power system* stabiliser;

(4) providing a 5 second ceiling excitation *voltage* of at least twice the excitation *voltage* required to achieve maximum continuous *reactive power* rating at nominal *voltage* and at nominal *active power output*; and

(5) providing *reactive* current compensation settable for droop or remote point *voltage* control.

(b) Synchronous generating units must be fitted with fast acting excitation control systems in accordance with good electricity industry practice.

(c) New non-synchronous generating units must be fitted with fast acting voltage and/or reactive power control systems in accordance with good electricity industry practice, which must be approved by the NSP.

(d) *Synchronous generating units* with ratings in excess of 30 MW or smaller *generating units* within a *power station* with a total *active power* output capability in excess of 30 MW must incorporate *power system* stabiliser (PSS) circuits which modulate the *generating unit* field voltage in response to *changes* in power output and/or shaft speed and/or any other equivalent input signal approved by the *NSP*.

The stabilising circuits must be responsive and adjustable over a *frequency* range which must include frequencies from 0.1 Hz to 2.5 Hz. *Power system* stabiliser circuits may be required on *synchronous generating units* with ratings less than or equal to 30 MW or smaller *synchronous generating units* within a *power station* with a total *active power* output capability less than or equal to 30 MW if *power system* simulations indicate a need for such a requirement.

Before commissioning of any *power system* stabiliser, the *generator* must propose preliminary settings for the *power system* stabiliser, which must be approved by the *NSP*

(e) *Power system* stabilisers may also be required for non-*synchronous generating units*. The performance characteristics of these *generating units* with respect to *power system stability* must be similar to those required for *synchronous generating units*. The requirement for a *power system* stabiliser and its structure and settings will be determined by the *NSP* from *power system* simulations.

(f) The performance characteristics required for AC exciter, rotating rectifier and *static excitation systems* are specified in Table 3.1; and

(g) The performance characteristics required for the *voltage* or *reactive power control systems* of all non-*synchronous generating units* are specified in Table 3.2

(h) The structure and parameter settings of all components of the *control system*, including the *voltage* regulator, *reactive power* regulator, *power system* stabiliser, power amplifiers and all excitation limiters, must be approved by the *NSP*.

(i) The structure and settings of the *voltage* / *excitation control system* must not be *changed*, corrected or adjusted in any manner without the prior written approval of the *NSP*.

Table 3.1 – Synchronous generator excitation control system performance requirements

Performance Item	Units	Static Excitation	AC Exciter or Rotating Rectifier	Notes
***Sensitivity*:** A sustained 0.5% error between the *voltage* reference and the sensed *voltage* must produce an excitation *voltage change* of not less than 1.0 per unit.	Open loop gain (ratio)	200 minimum	200 minimum	1
Field *voltage* rise time: Time for field *voltage* to rise from rated *voltage* to excitation ceiling *voltage* following the application of a short duration impulse to the *voltage* reference.	second	0.05 maximum	0.5 maximum	2, 4
Settling time with the *generating unit* unsynchronised following a disturbance equivalent to a 5% step *change* in the sensed *generating unit* terminal *voltage*.	second	1.5 maximum	2.5 maximum	3
Settling time with the *generating unit* synchronised following a disturbance equivalent to a 5% step *change* in the sensed *generating unit* terminal *voltage*. Must be met at all operating points within the *generating unit* capability.	second	2.5 maximum	5 maximum	3
Settling time following any disturbance which causes an excitation limiter to operate.	second	5 maximum	5 maximum	3

{Note:

1. One per unit excitation *voltage* is that field *voltage* required to produce nominal *voltage* on the air gap line of the *generating unit* open circuit characteristic (Refer IEEE Standard 115-1983 - Test Procedures for Synchronous Machines). *Excitation control system* with both proportional and integral actions must achieve a minimum equivalent gain of 200.
2. Rated field *voltage* is that *voltage* required to give nominal *generating unit* terminal *voltage* when the *generating unit* is operating at its maximum continuous rating. Rise time is defined as the time taken for the field *voltage* to rise from 10% to 90% of the increment value.
3. Settling time is defined as the time taken for the *generating unit* terminal *voltage* to settle and stay within an error band of ±10% of its increment value.
4. Field *voltage* means *generating unit* field *voltage*.}

Table 3.2 – Non-synchronous generator voltage or reactive power control system performance requirements

Performance Item	Units	Limiting Value	Notes
Sensitivity: A sustained 0.5% error between the reference *voltage* and the sensed *voltage* must produce an output *change* of not less than 100% of the *reactive power generation* capability of the *generating unit,* measured at the point of control.	Open loop gain (ratio)	200 minimum	1
Rise time: Time for the controlled parameter (*voltage* or *reactive power* output) to rise from the initial value to 90% of the *change* between the initial value and the final value following the application of a 5% step *change* to the *control system* reference.	second	1.5 maximum	2
***Small disturbance* settling time** Settling time of the controlled parameter with the *generating unit connected* to the *transmission or distribution network* following a step *change* in the *control system* reference that is not large enough to cause saturation of the controlled output parameter. Must be met at all operating points within the *generating unit's* capability.	second	2.5 maximum	3
***Large disturbance* settling time** Settling time of the controlled parameter following a *large disturbance*, including a *transmission or distribution network* fault, which would cause the maximum value of the controlled output parameter to be just exceeded.	second	5 maximum	3

{Note:

1. A *control system* with both proportional and integral actions must be capable of achieving a minimum equivalent gain of 200.
2. The controlled parameter and the point where the parameter is to be measured must be agreed and included in the relevant *access contract*.
3. Settling time is defined as the time taken for the controlled parameter to settle and stay within an error band of ±10% of its increment value.

(j) *Control system* settings may require alteration from time to time as advised by the *NSP*. The preliminary settings backed up by any calculations and system studies to derive these settings must be provided by the *NSP* at least two *months* before the system tests stated in clause 4.1.3 are undertaken. A *generator* must cooperate with the *NSP* by applying the new settings and participating in tests to demonstrate their effectiveness.

(k) Excitation limiters must be provided for under excitation and over excitation of *synchronous generating units* and may be provided for *voltage* to *frequency* ratio. The *generating unit* must be capable of stable operation for indefinite periods while under the control of any limiter. Limiters must not detract from the performance of any stabilising circuits and must have settings applied which are coordinated with all *protection systems*.

3.3.5 Power station auxiliary transformers

In cases where a *power station* takes its auxiliary supplies through a *transformer* by means of a separate *connection point*, the *controller* must comply with the conditions for *connection* of *loads* (refer to clause 3.6) in respect of that *connection point*.

3.3.6 Synchronising

(a) For a *synchronous generating unit* the *generator* must provide and install manual or automatic synchronising at the *generating unit* circuit breakers.

(b) The *generator* must provide check synchronising on all *generating unit* circuit breakers and any other circuit breakers, unless interlocked (as outlined in clause 3.6), that are capable of connecting the *controller's generating units* to the *network*.

(c) Prior to the initial *synchronisation* of the *generating unit(s)* to the *network*, the *generator* and the *NSP* must agree on written operational procedures for *synchronisation.*

3.3.7 Secure electricity supplies

A *generator* must provide secure electricity supplies of adequate capacity for the operation of *equipment* performing metering, communication, monitoring, and *protection* functions for at least 8 hours after the loss of AC supplies to that *equipment*.

3.3.8 Design requirements for generator's substations

A *generator* must comply with the requirements of clause 3.6.8.

3.3.9 Computer model

(a) A *generator* must provide to the *NSP* a software model of each *generating unit* suitable for use in the *ISO's power system model*. The model must automatically initialise its parameters from *load* flow simulations. Once a simulation case has been compiled, *changes* in the *load* flow such as *changes* in *voltage*, *generating unit* output (or the consumption of *consumer equipment*), *voltage* set point must not require the study case to be recompiled. The *NSP* must make the model available to the ISO for inclusion in the standard software package library, in accordance with the *power system modelling procedure*. The source code of the model must also be provided.

(b) *Generators* must demonstrate to the *NSP's* satisfaction, and the *NSP* must (with such assistance from the *generator* as the *NSP* reasonably requires) demonstrate to the *ISO's* satisfaction, that the model adequately represents the performance of the *generating unit* over its *load* range and over the system *frequency* operating range of clause 2.2.1, Table 2.1. The normal method of model verification is through testing.

(c) The structure and parameter settings of all components of the turbine and excitation control *equipment* must be provided to the *NSP* in sufficient detail to enable the dynamics of these components to be characterised in the computer model for short and long term simulation studies. This must include a control block diagram in suitable form to perform dynamic simulations and proposed and final parameter settings for the turbine and *excitation control systems* for all expected modes of *turbine control system* operation. The final parameter settings must not be varied without prior approval of the *NSP*.

(d) The applicable structure and parameter settings include:

(1) speed/load controller;

(2) key *protection* and control loops;

(3) actuators (for example hydraulic valve positioning systems); and

(4) limiters.

(e) A *generating unit* may be connected to the *network* if:

(1) the requirements of clauses 3.3.9(a) to 3.3.9(d) are fully complied with; or

(2) the *NSP*, acting reasonably, has agreed with the *controller* of the *generating unit*, in the relevant *access contract* or otherwise, on alternative arrangements to provide a replacement compatible software model of the *generating unit* should the *NSP* or *ISO* upgrade or *change* its *power system* simulation software.

(f) A *generator* that was *connected* to the *network* prior to the *Rules commencement date*, and which has not fully complied with the requirements of subclauses (a) to (d) of this clause 3.3.9, must support the computer model for *changes* in the nominated software for the duration of its connection to the *network*.

3.4 Requirements for connection of small generating units to the distribution network (1000 kVA up to 10 MW)

3.4.1 Overview

This clause addresses the particular requirements for the connection of small *generating units* and groups of small *generating units* of aggregate rated capacity up to 10 MW (small *power stations*) to the *distribution system*. This does not apply to the connection of *energy* systems rated at up to 1000 kVA and *connected* to the *low voltage* system via inverters, in respect of which clause 3.5 applies.

{Note: The issues addressed by this clause are:

1. the possibility that *generating units* embedded in *distribution systems* may affect the *quality of supply* to other *controllers*, cause reverse *power transfer*, use up *distribution system*

capacity, create a *distribution system* switching hazard and increase risks for operational personnel; and

2. the possibility that a small *power station connected* to a *distribution system* could become islanded on to a de-energised part of the *distribution system* resulting in safety and *quality of supply* concerns.

3.4.2 Categorisation of facilities

(a) This clause covers *generating units* of all types, whether using renewable or non-renewable *energy* sources.

(b) Unless otherwise specified, technical requirements for *generating units* will apply at the *connection point*, rather than at the *generator machine* terminals, except that the *reactive power* requirements for *synchronous generating units* will apply at the *generator machine* terminals.

(c) In this clause, *connection points* for small *power stations* are characterised as:

(1) *medium voltage connected*: 3 phase, 6.6 kV, 11 kV, 22 kV or 33 kV; or

(2) *low voltage connected*: 1, 2 or 3 phase plus neutral, 240 V or 415 V.

Where a small *power station* is the only *facility connected* to a *low voltage network* the *generator* may choose to have the *power station* assessed for compliance as if the *power station* was *medium voltage connected*. Prior to another *controller* subsequently connecting to the same *low voltage network*, the *NSP* must reassess the *power station* for compliance with the requirements for *low voltage connected power stations* and the *generator* must rectify any non-compliance identified in the reassessment.

(d) **Modes of operation**

In this clause, the mode of operation of a *generating unit* in a small *power station* is characterised as:

(1) being in continuous parallel operation with the *distribution system*, and either exporting electricity to the *distribution system* or not exporting electricity to it;

(2) being in occasional parallel operation with the *distribution system*, and either exporting electricity to the *distribution system* or not exporting electricity to it, including *generating units* participating in peak lopping and system *peak load* management for up to 200 hours per year;

(3) being in short term test parallel operation with the *distribution system*, and either exporting electricity to the *distribution system* or not exporting electricity to it, and having a maximum duration of parallel operation 2 hours per event and 24 hours per year; or

(4) bumpless (make before break) transfer operation, being:

(A) operation in rapid transfer mode where, when *load* is transferred between the *generating unit* and the *distribution system* or vice versa, the *generating unit* is synchronised for a maximum of one second per event; or

(B) operation in gradual transfer mode where, when *load* is transferred between the *generating unit* and the *distribution system* or vice versa, the *generating unit* is synchronised for a maximum of 60 seconds per event.

3.4.3 Information to be provided by the generator

(a) Clause 3.3.2 applies in relation to the small *power station*.

(b) When requested by the *NSP*, a *generator* must provide details of the proposed operation of the *equipment* during start-up, shut-down, normal daily operation, intermittent fuel or wind variations and under fault or *emergency conditions*.

(c) For *generating units* in a small *power station* of aggregate rating 5 MW and above, the *NSP* must assess the need for dynamic simulation studies and may require the *generator* to provide a computer model in accordance with the requirements of clause 3.3.9.

3.4.4 Safety and reliability

(a) The requirements imposed on a *generator* by this clause 3.4 are intended to provide minimum safety and *reliability* standards for the *distribution system* and other *controllers*. Subject to meeting these requirements, a *generator* must design its facilities in accordance with applicable standards and regulations, *good electricity industry practice* and the manufacturers' recommendations.

(b) The safety and *reliability* of the *distribution system* and the *equipment* of other *controllers* are paramount and *access applications* must be evaluated accordingly. *Generators* must not connect or reconnect to the *distribution system* if the safety and *reliability* of the *distribution system* would be placed at risk.

(c) Where it is apparent that the operation of *equipment* installed in accordance with the requirements of this clause 3.4 may nevertheless have an adverse impact on the operation, safety or performance of the *distribution system*, or on the *quality of supply* to other *controllers*, the *NSP* must consult with the *controller* to reach an agreement on an acceptable solution. As a consequence, the *NSP* may require the *generator* to test or modify its relevant *equipment*.

(d) Unless otherwise agreed in the relevant *access contract*, the *NSP* may require a *generator* not to operate *equipment* in abnormal *distribution system* operating conditions.

(e) *Equipment* directly *connected* to the *connection point* of a small *power station* must be rated for the *maximum fault current* at the *connection point* specified in clause 2.5.6.

(f) A *generator* must ensure that the *maximum fault current* contribution from a *generating unit* or small *power station* is not of a magnitude that will allow the total fault current at the *connection point* to exceed the levels specified in clause 2.5.6 for all *distribution system* operating conditions.

3.4.5 Requirements of clause 3.3 applicable to small power stations

Table 3.3 lists provisions of clause 3.3 that apply to small *power stations* in addition to the requirements of clause 3.4.

Table 3.3 - Specific paragraphs of clause 3.3 applicable to distribution-connected generating units rated up to 10 MW

Clause	Requirement
3.3.3.1	*Reactive power capability*
3.3.3.3	*Generating unit* response to disturbances in the Power system
	Except that *power stations* with less than 150 kW aggregate capacity need not comply with subclauses 3.3.3.3(c) and 3.3.3.3(g) unless directed otherwise by the *NSP*.
3.3.3.8	*Protection* of *generating units* from *power system* disturbances
3.3.4.4	*Frequency control*
	Except that *non-dispatchable induction generating units* need not comply with subclauses (a), (b), (d) and (e)(2) and f(2); and
	Except that *non-synchronous power station*s with less than 150 kW aggregate capacity do not have to comply with subclauses (a), (b) and (d)
3.3.4.5	*Voltage control system*
	Except that *non-synchronous generating units* may be fitted with *power factor control systems* utilising modern technology, unless *power system* studies show that fast acting *voltage* and/or *reactive power control systems* complying with subclause 3.3.4.5(c) are required.
	Subclause 3.3.4.5.(e) does not apply; and
	For *power station*s with a capacity of less than 150 kW subclause 3.3.4.5.(f) is replaced with:
	Generating units must have *voltage control systems* that ensure that the requirements of clause 3.4.8 are met at the *connection point*.

3.4.6 Generating unit characteristics

(a) To assist in controlling *distribution system* fault levels, *generators* must ensure that *generating units* comply with the *NSP's* requirements relating to *minimum fault current* and *maximum fault current* contribution through a *connection point*.

(b) If the connection or *disconnection* of a *controller's* small *power station* causes or is likely to cause excessively high or low fault levels, this must be addressed by other technical measures specified in the relevant *access contract*.

3.4.7 Connection and operation

3.4.7.1 Generators' substations

Generators' substations through which *generating units* are *connected* to the *distribution system* must comply with the requirements of clause 3.6.8.

3.4.7.2 Main switch

(a) Each *facility* at which a *generating unit* in a small *power station* is *connected* to the *distribution system* must contain one main switch provided by the *controller* for each *connection point* and one main switch for each *generating unit*, where a *generating unit* shares a *connection point* with other *generating units* or *loads*. For larger installations, additional *connection points* and main switches or a dedicated feeder may be required.

(b) Switches must be automatically operated, fault current breaking and making, ganged switches or circuit breakers. The relevant *facility* may also contain similarly rated interposed paralleling switches for the purpose of providing alternative synchronised switching operations.

(c) At each relevant *connection point* there must be a means of visible and lockable isolation and test points accessible to the *NSP's* operational personnel. This may be a withdrawable switch, a switch with visible contacts, a set of removable links or other means agreed between the *NSP* and the *controller* in accordance with *GEIP*. Subject to any such agreement, it must be possible for the *NSP's* operational personnel to fit safety locks on the isolation point.

{Note: *Low voltage generating units* with moulded case circuit breakers and fault limiting fuses with removable links are acceptable for isolation points in accordance with subclause 3.4.7.2(c).}

3.4.7.3 Synchronising

(a) For a *synchronous generating unit* in a small *power station*, a *generator* must provide automatic synchronising *equipment* at each *generating unit* circuit breaker.

(b) Check synchronising must be provided on all *generating unit* circuit breakers and any other switching devices that are capable of connecting the *controller's generating units* to the *distribution system* unless otherwise interlocked to the satisfaction of the *NSP*.

(c) Prior to the initial *synchronisation* of the *generating unit(s)* to the *distribution system*, the *generator* and the *NSP* must agree on written operational procedures for *synchronisation*.

3.4.7.4 Safe shutdown without external supply

A *generating unit* must be capable of being safely shut down without electricity *supply* being available from the *distribution system*.

3.4.8 Power quality and voltage change

(a) A *generator* must ensure that the performance standards of clause 2.2 are met when a small *power station* is *connected* by it to the *distribution system*.

(b) The step *voltage change* at the *connection point* for connection and *disconnection* must comply with the requirements of clause 2.2.2. These requirements may be achieved by synchronising individual *generating units* sequentially. On *low voltage* feeders, *voltage changes* up to 5% may be allowed in some circumstances with the approval of the *NSP*.

(c) The steady state *voltage* rise at the *connection point* resulting from export of power to the *distribution system* must not cause *voltage* limits specified in clause 2.2 to be exceeded and, unless otherwise agreed with the *NSP*, must not exceed 2%.

{Note: The 2% limit on the *voltage* rise specified in this subclause 3.4.8(c) may be waived if the *generator* is contracted by the *NSP* for the provision of *voltage* control services. Such a waiver is most likely to be necessary at fringe of *distribution system* locations.}

(d) When operating unsynchronised, a *synchronous generating unit* in a small *power station* must generate a constant *voltage* level with balanced phase *voltages* and harmonic *voltage* distortion equal to or less than permitted in accordance with either *Australian Standard AS* 1359 (1998) - "General Requirements for Rotating Electrical Machines" or a recognised relevant international standard, as agreed between the *NSP* and the *controller*.

3.4.9 Remote control, monitoring and communications

(a) For *generating units* exporting 1 MW or more to the *distribution system* the *generator* must provide for:

(1) tripping of the *generating unit* remotely from the *NSP's control centre*;

(2) a close-enable interlock operated from the *NSP's control centre*; and

(3) remote monitoring at the *control centre* of (signed) MW, MVAr and *voltage*.

(b) For *generating units* exporting less than 1 MW monitoring may not be required. However, where concerns for safety and *reliability* arise that are not adequately addressed by automatic *protection systems* and interlocks, the *NSP* may require the *generator* to provide remote monitoring and remote control of some functions in accordance with subclause 3.4.9(a).

(c) A *generator* must provide a continuous communication link with the *NSP's control centre* for monitoring and control for *generating units* exporting 1 MW and above to the *distribution system*. For *generating units* exporting below 1 MW, non-continuous monitoring and control may be required e.g. a bi-directional dial up arrangement.

(d) A *generator* must have available at all times a telephone link or other communication channel to enable voice communications between a small *power station* and the *NSP's control centre*. For *generating units* exporting above 1 MW, a back-up speech communications channel pursuant to subclause 3.3.4.3(d) may be required.

3.4.10 Protection

This clause 3.4.10 applies only to *protection* necessary to maintain *security*. A *generator* must design and specify any additional *protection* required to guard against risks within the *generator's facility*.

3.4.10.1 General

(a) A *generator* must provide, as a minimum, the *protection* functions specified in this subclause 3.4.10.1 in accordance with the aggregate rated capacity of *generating units* in a small *power station* at the *connection point*.

(b) A *generator's* proposed *protection system* and settings must be approved by the *NSP*, who must assess their likely effect on the *distribution system* and may specify modified or additional requirements to ensure that the performance standards specified in clause 2.2 are met, the *power transfer capability* of the *distribution system* is not reduced and the *quality of supply* to other *controllers* is maintained. Information that may be required by the *NSP* prior to giving approval is to be specified under Attachment 5 and Attachment 10.

(c) A *generator's protection system* must clear internal plant faults and coordinate with the *NSP's protection system*.

(d) The design of a *generator's protection system* must ensure that failure of any *protection* device cannot result in the *distribution system* being placed in an unsafe operating mode or lead to a disturbance or safety risk to the *NSP* or to other *controllers*.

{Note: This may be achieved by providing back-up *protection schemes* or designing the *protection system* to be fail-safe, e.g. to trip on failure.}

(e) All *protection apparatus* must comply with the IEC 60255 series of standards. Integrated control and *protection apparatus* may be used provided that it can be demonstrated that the *protection* functions are functionally independent of the control functions, i.e. failure or mal-operation of the control features will not impair operation of the *protection system*.

{Note: Subclause 1.9.3(b) specifies the process whereby the *Rules* may be *changed* to include alternatives to the standards currently specified.

(f) All small *power stations* must provide under and over *voltage*, under and over *frequency* and overcurrent *protection schemes* in accordance with the *equipment* rating.

(g) All small *power stations* must provide earth fault *protection* for earth faults on the *distribution system*. All small *power stations connected* at *medium voltage* must have a sensitive earth fault *protection scheme*.

{Note: The earth fault *protection scheme* may be earth fault or neutral *voltage* displacement (depending on the earthing system arrangement).}

{Note: Clause 3.4.10.1(g) is exempt for inverter connected generating units of 30 to 150 kVA which comply with AS 4777 and IEC 62116 connected to the grid at *low voltage*, provided Rate of Change of Frequency (RoCoF) protection is enabled in the external generator *protection* relay with a setting of 4 Hz/sec and a sampling rate of 4 cycles. For these inverter-connected generating units, all *protection* functions required by AS/NZS 4777 shall be implemented}

(h) All small *power stations* must provide *protection* against abnormal *distribution system* conditions, as specified in clause 3.3.3.8, on one or more phases.

(i) All small *power stations* that have an export limit shall have directional (export) power or directional current limits set appropriate to the export limit.

(j) All small *power stations* must have loss of AC and DC auxiliary *supply protection*, which must immediately trip all switches that depend on that *supply* for operation of their *protection*, except where the auxiliary *supply* is duplicated in which case the failure may be alarmed in accordance with clause 3.4.12.

(k) Where *synchronisation* is time limited, the small *power station* must be *disconnected* by an independent timer

(l) *Generating units* that are only operated in parallel with the *distribution system* during *rapid bumpless transfer* must be protected by an independent timer that will *disconnect* the *generating unit* from the *distribution system* if the bumpless transfer is not successfully completed. Automatic transfer switches must comply with *AS* 60947.6.2 (2004). For the avoidance of doubt, *generating units* covered by this clause need not comply with subclauses (f) to (k) of this clause 3.4.10.1.

{Note: The above exemption from subclauses (f) to (k) of clause 3.4.10.1 recognises that the *rapid bumpless transfer* will be completed or the *generating unit* will be *disconnected* by the *disconnection* timer before other *protection schemes* operate. *Protection* of the *generating unit* when it is not operating in parallel with the *distribution system* is at the discretion of the *generator*.}

3.4.10.2 Pole slipping

The *generator* must install a pole slipping *protection scheme* as a backup to primary protection, which should disconnect generators following a loss of *synchronism*, in turn following a *credible contingency event.*

3.4.10.3 Islanding protection

(a) No small *power station* may *supply* power into any part of the *distribution system* that is *disconnected* from the *power system*.

{Note: The *protection* against loss of external *supply* (loss of mains) may be *voltage* vector shift, directional (export) power or directional over current or any other method, approved by the *NSP,* that can detect a balanced *load* condition in an islanded state.}

(b) For parallel operation (which excludes rapid or *gradual bumpless transfer*), islanding *protection schemes* of two different functional types must be provided to prevent a *generating unit* energising a part of the *distribution system* that has become isolated from the remainder of the *network* under all operating modes. The *generator* must demonstrate that two different functional types of islanding *protection schemes* have been provided.

(c) For *power stations* rated above 1 MW, each functional type of islanding *protection scheme* must be incorporated into a physically separate *protection* relay. These may share the same *voltage* and *current transformers* but must be *connected* to different secondary windings. This requirement may be applied to *power stations* rated below 1 MW in situations where it is possible for the *power station* to support a sustained island on a part of the *medium voltage distribution system*.

(d) Except as provided in subclause 3.4.10.3(c), where a *power station* is rated at less than 1 MW the two islanding *protection schemes* may be incorporated into the same multi-function *protection* relay, provided that the overcurrent and earth fault *protection schemes* required by subclauses 3.4.10.1 (f) and 3.4.10.1 (g) are in a physically separate relay.

(e) Where there is no export of power into the *distribution system* and the aggregate rating of the *power station* is less than 150 kW, islanding *protection schemes* can be in the form of a directional power function that will operate for power export. Directional overcurrent relays may also be used for this purpose.

(f) *Generating units* designed for *gradual bumpless transfer* must be protected with at least one functional type of loss of mains *protection scheme*.

(g) Islanding *protection* must operate within 2 seconds to ensure *disconnection* before the first *distribution system* reclosing attempt (typically 5 seconds). Relay settings are to be agreed with the *NSP*.

{Note: It should be assumed that the *NSP* will always attempt to auto-reclose to restore *supply* following transient faults.

3.4.11 Inter-tripping

In cases where, in the opinion of the *NSP*, the risk of undetected islanding of part of the *distribution system* and the *generator's facility* remains significant, the *NSP* may also require the installation of an inter tripping link between the *generator's* main switch(es) and the feeder circuit breaker(s) in the *substation* or other upstream *protection* device nominated by the *NSP*.

3.4.12 Failure of generator's protection equipment

Any failure of the generator's protection apparatus must automatically trip the generating unit's main switch except, where the affected protection apparatus forms part of a protection system comprised of two fully independent protection schemes of differing principle, the failure may instead be alarmed within the generator's facility provided that operating procedures are in place to ensure that prompt action is taken to remedy such failures.

3.4.13 Commissioning and testing

The *generator* must comply with the testing and commissioning requirements for *generating units connected* to the *distribution system* which are to be specified under Attachment 12.

3.5 Requirements for connection of energy to the low voltage distribution system via inverters (up to 1000 kVA)

(a) An *NSP* (after consulting with the *ISO*) must develop and maintain, and may from time to time update, a *procedure* setting out its requirements for the connection of *energy* systems to the *NSP's low voltage distribution system* via inverters. It covers installations rated up to 1000 kVA. For similarly rated non-inverter-*connected energy* systems, the requirements of clause 3.4 apply.

(b) The *procedure* is to be consistent with:

(1) GEIP;

(2) for a covered network, the Pilbara electricity objective;

(3) the objective of maintaining and improving *security.*

(c) The *NSP* must provide a copy of its current *procedure* to the *ISO*.

(d) The *NSP* of a *covered network* must *publish* a copy of its current *procedure*.

{Note: The scope of this clause is limited to technical conditions of connection. The *NSP* is able to enter into an *energy* buyback agreement with a *controller*. It should also be noted that whereas this clause covers *connection* issues for *generators* up to 1000 kVA, the maximum *generator* capacity for which an *NSP* may be prepared to enter into an *energy* buyback agreement may be less than this amount.}

3.6 Requirements for connection of loads

3.6.1 Obligations of consumers

(a) A *consumer* must ensure that all facilities associated with the relevant *connection point* at all times comply with the applicable requirements and conditions of connection for *loads*:

(1) as set out in this clause; and

(2) in accordance with any relevant *access contract* with the *NSP*.

(b) A *consumer* must operate all *consumer facilities* and *equipment* in accordance with any and all *directions* given by the *NSP* or the *ISO* under these *Rules* or under any *written law*.

3.6.2 Overview

(a) This clause applies to the connection of *equipment* and facilities of *consumers* to the *network*.

(b) The requirements set out in this clause generally apply to the connection of a large *load* to the *transmission* or distribution *network*. The specific requirements for the connection of a particular *consumer's equipment* and facilities will be agreed between the *NSP* and the *consumer* and will depend on the magnitude and other characteristics of the *consumer's load*, the *power transfer* capacity, *voltage* and location of the *connection point*, and characteristics of the local *network* in the vicinity of the *connection point*.

(c) A *consumer* must provide *equipment* capabilities, *protection* and *control systems* that ensure that its *load*:

(1) does not cause excessive *load* fluctuations, *reactive power* draw or, where applicable, stalling of motor *loads* that would have an adverse impact on other *controllers*, the *NSP* or the performance of the *power system*.

(2) does not cause any reduction of inter-regional or intra-regional *power transfer capability* based on:

(A) frequency stability, or

(B) *voltage* stability,

by more than its *load*ing level whenever *connected* relative to the level that would apply if the *consumer* were *disconnected.*

{Note: This requirement is intended to safeguard from transients caused by relatively large *consumers* with a high proportion of motor *loads*; for example, to safeguard one mining operation from another.}

3.6.3 Power frequency variations

A *consumer* must ensure that the *equipment connected* to its *connection point* is capable of continuous uninterrupted operation (other than when the *facility* is faulted) if variations in *supply frequency* of the kind described in subclause 2.2.1(c) occur.

3.6.4 Power frequency voltage variations

A *consumer* must ensure that the *equipment connected* to its *connection point* is capable of continuous uninterrupted operation (other than when the *facility* is faulted) if variations in *supply voltage* of the kind described in clause 2.2.2 occur.

3.6.5 Provision of information

(a) Subject to clause 3.6.5(d), before connection to the *network*, a *consumer* must provide all data relevant to each *connection point* that is reasonably required by the *NSP* in order to complete the detailed design and installation of the relevant *connection assets*, to ensure that there is sufficient *power transfer capability* in the *network* to *supply* the *consumer's load* and that connection of the *consumer's load* will not have an adverse impact other *controllers*, or on the performance of the *power system*.

(b) The specific data that must be provided by a *consumer* in respect of a particular *connection point* will depend on characteristics of the *consumer's* *loads*, the *power transfer* capacity of the *connection point* as specified in the relevant *access contract*, the *voltage* and location of the *connection point*, and characteristics of the local *network* in the vicinity of the *connection point*. Subject to clause 3.6.5(d), *equipment* data that may need to be provided includes:

(1) interface *protection* details including, line diagram, grading information, secondary injection and trip test certificate on all circuit breakers;

(2) metering system design details for *equipment* being provided by the *consumer*;

(3) a general arrangement locating all the major *loads* on the site;

(4) a general arrangement showing all exits and the position of all electrical *equipment* in *substations* that are directly *connected* to the *connection point*;

(5) type test certificates for new switchgear and *transformers*, including measurement *transformers* to be used for metering purposes;

(6) the proposed methods of earthing cables and other *equipment* plus a single line earthing diagram;

(7) *equipment* and earth grid test certificates from approved test authorities;

(8) operational procedures;

(9) details of time-varying, non-sinusoidal and potentially disturbing *loads*;

(10) SCADA arrangements;

(11) *load* details including maximum demand profiles;

(12) a line diagram and service or incoming cable routes and sizes; and

(13) the preferred location of the *connection point*.

{Note: Typically, the *controller* in respect of a small domestic *consumer* will only be required to provide the data referred to in subclauses 3.6.5(b)(12) and subclause 3.6.5(b)(13).}

(c) In addition to the requirements in subclause 3.6.5(a) and (b) but subject to clause 3.6.5(d), the *consumer* must provide *load* data reasonably required by the *NSP*.

{Note: If the ISO is doing any analysis, the *NSP* will be required by the *Pilbara networks rules* to pass on all information the ISO reasonably requires, which will include information obtained under this clause 3.3.2.}

(d) For a covered network:

(1) the *NSP* must not under this clause 3.6.5 require more information than is reasonably necessary in accordance with *GEIP* to enable the *NSP* to assess the application and make an access offer; and

(2) the *User Access Guide* published under the *PNAC* must set out clearly the information the *NSP* is likely to require under this clause 3.6.5.

{Note: For a non-covered network, the *NSP* may determine from time to time what information it requires.}

3.6.6 Design standards

(a) The equipment connected to a consumer's connection point must comply with the relevant Australian Standards as applicable at the time of first installation of the equipment, the Electricity (Network Safety) Regulations 2015 (WA), good electricity industry practice and these Rules and it must be capable of withstanding the power frequency voltages and impulse levels specified by the NSP.

(b) The circuit breakers, fuses and other *equipment* provided to isolate a *consumer's* facilities from the *transmission* and *distribution system* in the event of a fault must be capable of breaking, without damage or restrike, the fault currents specified by the *NSP* for the relevant *connection point*.

(c) The *equipment* ratings *connected* to a *consumer's connection point* must coordinate with the *equipment* installed on the *power system*.

3.6.7 Power factor requirements

(a) *Power factor* ranges to be met by *loads connected* to the *transmission system* and those *connected* to the *distribution system* and rated 1 MVA or more are shown in the Table 3.6.

Table 3.6 – Power factor requirements for loads

Permissible Range	
Supply Voltage (nominal)	*Power factor* range (half-hour average, unless otherwise specified by the *NSP*)
220 kV	0.96 lagging to unity
66 kV / 132 kV	0.95 lagging to unity
<66 kV	0.9 lagging to 0.9 leading
Distribution Networks	0.8 lagging to 0.8 leading

(b) The *power factor* range to be met by *loads* of less than 1 MVA *connected* to the *distribution system* is 0.8 lagging to 0.8 leading. Where necessary to ensure the satisfactory operation of the *distribution system*, a different *power factor* range may be specified in the relevant *access contract*.

(c) The *NSP* may permit a lower lagging or leading *power factor* where this will not reduce system *security* and/or *quality of supply*, or require a higher lagging or leading *power factor* to achieve the *power transfers* required by the *load*.

(d) A *shunt capacitor* installed to comply with *power factor* requirements must comply with the *NSP's* requirements to ensure that the design does not severely attenuate audio *frequency* signals used for *load* control or operations.

(e) A *static VAr compensator* system installed for either *power factor* or *quality of supply* requirements must have a *control system* that does not interfere with other control functions on the electricity *transmission* and *distribution system*. Adequate filtering facilities must be provided if necessary to absorb any excessive harmonic currents.

3.6.8 Design requirements for consumers' substations

Equipment in or for any *consumer's substation* that is *connected* directly to a *connection point* must comply with the following requirements:

(a) safety provisions that comply with the requirements of the *NSP* must be incorporated into the *substation* facilities;

(b) where required by the *NSP*, interfaces and accommodation must be provided by the *consumer* for metering, communication, remote monitoring and *protection equipment* to be installed in the *substation* by the *NSP*;

(c) the *substation* must be capable of continuous uninterrupted operation within the system performance standards specified in clause 2.2;

(d) the *transformer* vector group must be agreed with the *NSP*. The vector group must be compatible with the *power system* at the *connection point* and preference be given to vector groups with a zero sequence opening between *high or medium voltage* and *low voltage* windings.

(e) earthing of *primary equipment* in the *substation* must be in accordance with the *WA Electrical Requirements*, *AS* 2067 for *medium and high voltage equipment* or *AS*/NZS 3000 (2000) for *low voltage equipment*. The earthing system must satisfy these requirements without any reliance on the *NSP's equipment*; Where it is not possible to design a compliant earthing system within the boundaries of a *consumer's* plant, the *NSP* must provide a *consumer*, access to its easement for the installation of earthing conductors and stakes where it is practical to do so and provided that this is not precluded by any legal requirement.

(f) *synchronisation* facilities or reclose blocking must be provided if *generating units* are *connected* through the *substation*; and

(g) insulation levels of *equipment* in the *substation* must coordinate with the insulation levels of the *transmission* and *distribution system* to which the *substation* is *connected* without degrading the design performance of the *transmission* and *distribution system*.

3.6.9 Load shedding facilities

Consumers must provide automatic *load shedding* facilities where required by the *NSP* in accordance with subclause 2.3.1(c).

3.6.9.1 Installation and testing of load shedding facilities

A *consumer* that controls a *load* subject to *load shedding* in accordance with subclause 2.3.1(c) must:

(a) provide, install, operate and maintain *equipment* for *load shedding*;

(b) co-operate with the *NSP* in conducting periodic functional testing of the *load shedding equipment*, which must not require *load* to be *disconnected*;

(c) apply under-*frequency* settings to relays as determined by the *NSP*; and

(d) apply under-*voltage* settings to relays as determined by the *NSP*.

3.6.10 Monitoring and control requirements

3.6.10.1 Remote monitoring

(a) The NSP or the ISO may require large transmission and distribution connected consumers to:

  (1) provide *remote monitoring equipment* (*RME*) to enable the *NSP* to monitor the status and indications of the *load* remotely where this is necessary in real time for management, control, planning or *security* of the *power system*; and

  (2) upgrade, modify or replace any *RME* already installed in a *consumer's substation* where the existing *RME* is, in the opinion of the *NSP*, no longer fit for purpose and notice is given in writing to the relevant *consumer*.

(b) An *RME* provided, upgraded, modified or replaced (as applicable) in accordance with subclause 3.6.10.1(a) must conform to an acceptable standard as agreed by the *NSP* and must be compatible with the *NSP's SCADA system*, including the requirements of clause 5.10.

(c) Input information to *RME* may include the following:

  (1) status indications

    (A) relevant circuit breakers open/closed (dual point) within the *equipment*;

    (B) relevant isolators within the *equipment*;

    (C) connection to the *network*; and

    (D) relevant earth switches;

(2) alarms

(A) *protection* operation;

(B) protection fail;

(C) battery fail - AC and DC;

(D) trip circuit supervision; and

(E) trip supply supervision;

(3) measured values

(A) active power load;

(B) reactive power load;

(C) *load* current; and

(D) relevant *voltages* throughout the *equipment*, including *voltage* on the *NSP* side of main switch.

3.6.10.2 NSP's communications equipment

Where *remote monitoring equipment* is installed in accordance with clause 3.6.10.1, the *consumer* must provide communications paths (with appropriate redundancy) between the *remote monitoring equipment* and a communications interface in a location reasonably acceptable to the *NSP*. Communications systems between this communications interface and the relevant *control centre* are the responsibility of the *NSP* unless otherwise agreed.

3.6.11 Secure electricity supplies

All *consumers* must provide secure electricity supplies of adequate capacity to provide for the operation for at least 8 hours of *equipment* performing metering, communication, monitoring, and *protection* functions, on loss of AC supplies.

3.6.12 Computer model

(a) An *NSP* must develop a *procedure* (**"network modelling procedure"**) setting out its requirements for modelling *consumer facilities* which exceed the *power system modelling threshold*, including for communication and verification of models. The *procedure* must be compatible with the *power system modelling procedure*.

(b) A *consumer* must in accordance with the *NSP's procedure* under clause 3.6.12(a) provide to the *NSP* a software model of each *consumer facility* suitable for use in the *power system model*. The *NSP* must make the model available to the ISO for inclusion in the standard software package library, in accordance with the *power system modelling procedure*. The source code of the model must also be provided.

(c) An *NSP* must ensure that a *consumer facility* does not connect to the *network* without this clause 3.6.12 first being complied with.

3.7 Requirements for connection of storage

(a) The *NSP* and the *ISO* must collaborate regarding, and the *ISO* may determine, the requirements for connection of *storage facilities* to the *network*, having regard to:

(1) the system security objective; and

(2) *GEIP*; and

(3) the Pilbara electricity objective; and

(4) subject to paragraphs 3.7(a)(1), 3.7(a)(2) and 3.7(a)(3), the objective that these *harmonised technical rules* and the *Pilbara networks rules* be technology-neutral wherever practicable.

(b) Without limiting clause 3.7(a), the *NSP* and *ISO* may choose to apply these *harmonised technical rules* to a *storage facility* by treating it:

(1) in respect of its *injections* — as a *generating unit*; and

(2) in respect of its withdrawals — as consumer equipment.

4 Inspection, testing, commissioning, disconnection and reconnection

{Note: As in the rest of these rules, the ISO may have a role in respect of the matters discussed in this Chapter 4 even if it is not specifically mentioned. Under subchapter 2.4 of the *Pilbara networks rules*, the ISO must be consulted if the ISO or the relevant procedure requires, and may be consulted at other times. If the ISO is being consulted, controllers etc must cooperate.

The ISO also has certain overarching powers under the *Pilbara networks rules* to intervene if *security* is at risk.}

4.1 Inspection and testing

4.1.1 Right of entry and inspection

(a) The *NSP*, the *ISO,* or any *controller* whose *equipment* is *connected* directly to the *transmission system* and who is bound by these *Rules* (a reference to any of whom, for the purposes of this clause 4.1.1, includes its *representatives*) (in this clause 4.1.1 the **"inspecting party"**) may, in accordance with this clause 4.1.1, enter and inspect any *facility* of the *NSP* or any *controller* whose *equipment* is *connected* directly to the *transmission system* and who is bound by these *Rules* (in this clause 4.1.1 the **"facility owner"**) and the operation and maintenance of that *facility* in order to:

(1) assess compliance by the *facility owner* with its obligations under these *Rules*, or any relevant *access contract*;

(2) investigate any operating incident in accordance with clause 5.6.3;

(3) investigate any potential threat by that *facility* to *security*; or

(4) conduct any periodic familiarisation or training associated with the operational requirements of the *facility*.

(b) If an inspecting party wishes to inspect a *facility* under subclause 4.1.1(a), the inspecting party must give the *facility* owner at least:

(1) 2 *business days'* notice or as otherwise agreed by the parties, or

(2) 10 *business days'* notice for a non-urgent issue, in writing of its intention to carry out an inspection.

(c) In the case of an emergency condition affecting the *network* which the *NSP* or the *ISO* reasonably considers requires urgent access to a *facility*, prior notice to the *facility* owner is not required. However, the *NSP* or the *ISO*, as the case may be, must notify the *facility* owner as soon as practicable of the nature and extent of the activities it proposes to undertake, or which it has undertaken, at the *facility*.

(d) A notice given by an inspecting party under subclause 4.1.1(b) must include the following information:

(1) the name of the inspecting party's *representative* who will be conducting the inspection;

(2) the time when the inspection will commence and the expected time when the inspection will conclude; and

(3) the relevant reasons for the inspection.

(e) An inspecting party must not carry out an inspection under this clause 4.1.1 within 6 *months* of any previous inspection by it, except for the purpose of verifying the performance of corrective action claimed to have been carried out in respect of a non-conformance observed and documented on the previous inspection or, in the case of the *NSP* or the *ISO*, for the purpose of investigating an operating incident in accordance with clause 5.6.3.

(f) At any time when the *representative* of an inspecting party is in a *facility* owner's *facility*, that *representative* must:

(1) not cause any damage to the *facility*;

(2) interfere with the operation of the *facility* only to the extent reasonably necessary and as approved by the *facility* owner (such approval not to be unreasonably withheld or delayed);

(3) observe "permit to test" access to site and clearance protocols applicable to the *facility*, provided that these are not used by the *facility* owner or any contractor or agent of the *facility* owner solely to delay the granting of access to the *facility* or its inspection;

(4) observe the requirements in relation to occupational health and safety and industrial relations matters which are of general application to all invitees entering on or into the *facility*, provided that these requirements are not used by the *facility* owner or any contractor or agent of the *facility* owner solely to delay the granting of access to the *facility*; and

(5) not ask any question other than as may be reasonably necessary for the purpose of such inspection, nor give any *direction* or instruction to any person involved in the operation or maintenance of the *facility* other than in accordance with these *Rules* or, where the inspecting party and the *facility* owner are parties to an *access contract*, that *access contract*.

(g) Any *representative* of an inspecting party conducting an inspection under this clause 4.1.1 must be appropriately qualified and experienced to perform the relevant inspection. If so requested by the *facility* owner, the inspecting party must procure that its *representative* (if not a direct employee of the inspecting party) enters into a confidentiality undertaking in favour of the *facility* owner in a form reasonably acceptable to the *facility* owner prior to seeking access to the relevant *facility*.

(h) An inspection under this subclause 4.1.1(a) must not take longer than one day unless the inspecting party seeks approval from the *facility* owner for an extension of time (which approval must not be unreasonably withheld or delayed).

(i) Any *equipment* or goods installed or left on land or in premises of a *facility* owner after an inspection conducted under this clause 4.1.1 do not become the property of the *facility* owner (notwithstanding that they may be annexed or affixed to the land on which the *facility* is situated).

(j) In respect of any *equipment* or goods left by an inspecting party on land or in premises of a *facility* owner during or after an inspection, the *facility* owner must, and any person who owns or occupies the land on which the *facility* is situated or any part thereof does:

(1) take reasonable steps to ensure the *security* of any such *equipment*;

(2) not use any such *equipment* or goods for a purpose other than as contemplated in these *Rules* without the prior written approval of the inspecting party;

(3) allow the inspecting party to remove any such *equipment* or goods in whole or in part at a time agreed with the *facility* owner, which agreement must not be unreasonably withheld or delayed; and

(4) not create or cause to be created any mortgage, charge or lien over any such *equipment* or goods.

(k) Provided the *inspecting party* complies at all times with these rules, the *facility owner* and the *NSP* must permit, and cooperate in relation to, any inspection under this clause 4.1.1.

(l) If this clause 4.1.1 places obligations on a *facility owner* who is not a *controller*, the relevant *controller* must procure the *facility owner's* compliance with this clause.

4.1.2 Right of testing

(a) If the *NSP* or any *controller* whose *equipment* is *connected* directly to the *transmission system* under an *access contract* (in this clause 4.1.2 the **"requesting party"**) believes that *equipment* owned or operated by, or on behalf of, the other party to the *access contract* (in this clause 4.1.2 the **"*equipment* owner"**) may not comply with these *Rules* or the *access contract*, the requesting party may require testing by the *equipment* owner of the relevant *equipment* by giving notice in writing to the *equipment* owner accordingly.

(b) If a notice is given under subclause 4.1.2(a), the relevant test must be conducted at a reasonable time mutually agreed by the requesting party and the *equipment* owner and, where the test may have an impact on the *security* of the *power system*, the *NSP* as the case requires. Such agreement must not be unreasonably withheld or delayed.

(c) An *equipment* owner who receives a notice under subclause 4.1.2(a) must cooperate in relation to conducting the tests requested by that notice.

(d) Tests conducted in respect of a *connection point* under this clause 4.1.2 must be conducted using test procedures agreed between the *NSP*, the relevant *controllers*, which agreement must not be unreasonably withheld or delayed.

(e) Tests under this clause 4.1.2 may be conducted only by persons with the relevant skills and experience.

(f) A requesting party may appoint a *representative* to witness the test requested by it under this clause 4.1.2 test and the *equipment* owner must permit a *representative* so appointed to be present while the test is being conducted.

(g) Subject to subclause 4.1.2(h), an *equipment* owner who conducts a test must submit a report to the requesting party and, where the test was one which could have had an impact on the *security* of the *power system* the *NSP* and the *ISO*, within a reasonable period after the completion of the test. The report must outline relevant details of the tests conducted, including, but not limited to, the results of those tests.

(h) The *NSP* may attach test *equipment* or *monitoring equipment* to *equipment* owned by a *controller* or require a *controller* to attach such test *equipment* or *monitoring equipment*, subject to the provisions of clause 4.1.1 regarding entry and inspection. The data from any such test *equipment* or *monitoring equipment* must be read and recorded by the *equipment* owner.

(i) In carrying out monitoring under subclause 4.1.2(i), the *NSP* must not cause the performance of the monitored *equipment* to be constrained in any way.

(j) If a test under this clause 4.1.2 or monitoring under subclause 4.1.2(i) demonstrates that *equipment* does not comply with these *Rules* or the relevant *access contract*, then the *equipment* owner must:

(1) promptly notify the requesting party of that fact;

(2) promptly advise the requesting party of the remedial steps it proposes to take and the timetable for such remedial work;

(3) diligently undertake such remedial work and report at *monthly* intervals to the requesting party on progress in implementing the remedial action; and

(4) conduct further tests or monitoring on completion of the remedial work to confirm compliance with the relevant requirement.

(k) If this clause 4.1.2 places obligations on an *equipment owner* who is not a *controller*, the relevant *controller* must procure the *equipment owner's* compliance with this clause.

4.1.3 Tests to demonstrate compliance with connection requirements for generators

(a) Not used.

(b) Tests:

(1) A *generator* must provide evidence to the *NSP* that each of its *generating units* complies with the technical requirements of clause 3.3 or 3.4, as applicable, and the relevant *access contract,* prior to commencing commercial operation. In addition, each *generator* must cooperate with the *NSP* in carrying out *power system* tests prior to commercial operation in order verify the performance of each *generating unit*, and provide information and data necessary for computer model validation. The test requirements for *synchronous generating units and* for non-synchronous *generating units* are to be specified under Attachment 11.

(2) Special tests may be specified by the *NSP* where reasonably necessary to confirm that the *security* and performance standards of the *power system* and the *quality of supply* to other *controllers* will not be adversely affected by the connection or operation of a *generator's equipment*. The requirement for such tests must be determined on a case by case basis and the relevant *generator* must be advised accordingly. Examples of these special tests are to be specified under Attachment 11. Where testing is not practicable in any particular case, the *NSP* may (subject, in a *covered network*, to the *Access Code* and the *ISO's* supervision under Subchapter 9.2 of the *Pilbara networks rules*) require the *generator* to install recording *equipment* at appropriate locations in order to monitor *equipment* performance.

(3) These compliance tests must only be performed after the machines have been tested and certified by a Chartered Professional Engineer with National Professional Engineers' Register standing qualified in a relevant discipline, unless otherwise agreed, and after the machine's turbine controls, AVR, excitation limiters, *power system* stabiliser, and associated *protection* functions have been calibrated and tuned for commercial operation to ensure stable operation both on-line and off-line. All final settings of the AVR, PSS and excitation limiters must be indicated on control transfer block diagrams and made available to the *NSP* before the tests.

(4) A *generator* must forward test procedures for undertaking the compliance tests required in respect of its *equipment*, including details of the recorders and measurement *equipment* to be used in the tests, to the *NSP* for approval 30 *business days* before the tests or as otherwise agreed. The *generator* must provide all necessary recorders and other measurement *equipment* for the tests.

(5) A *generator* must also coordinate the compliance tests in respect of its *equipment* and liaise with all parties involved, including the

NSP. The *NSP* may witness the tests and must be given access to the site for this purpose, but responsibility for carrying out the tests remains with the *generator*.

(6) All test results and associated relevant information including final transfer function block diagrams and settings of automatic *voltage* regulator, *power system* stabiliser, under excitation limiter and over excitation limiter must be forwarded to the *NSP* within 10 business days after the completion of the test.

(c) A *generator* must negotiate in good faith with the *NSP* and agree on a compliance monitoring program, following commissioning, for each of its *generating units* to confirm ongoing compliance with the applicable technical requirements of clause 3.3 or 3.4, as applicable, and the relevant *access contract*. The negotiations must consider the use of high speed data recorders and similar non-invasive methods for verifying the *equipment* performance to the extent that such non-invasive methods are practicable.

(d) If compliance testing or monitoring of in-service performance demonstrates that a *generating unit* is not complying with one or more technical requirements of clause 3.3 and the relevant *access contract,* then the *generator* must:

(1) promptly notify the *NSP* of that fact;

(2) promptly advise the *NSP* of the remedial steps it proposes to take and the timetable for such remedial work;

(3) diligently undertake such remedial work and report at *monthly* intervals to the *NSP* on progress in implementing the remedial action; and

(4) conduct further tests or monitoring on completion of the remedial work to confirm compliance with the relevant technical requirement.

(e) If the *NSP* reasonably believes that a *generating unit* is not complying with one or more technical requirements of clause 3.3 or 3.4, as applicable, and the relevant *access contract*, the *NSP* may require the *generator* to conduct tests within an agreed time to demonstrate that the relevant *generating unit* complies with those technical requirements and if the tests provide evidence that the relevant *generating unit* continues to comply with the technical requirement(s), the *NSP* must reimburse the *generator* for the reasonable expenses incurred as a direct result of conducting the tests.

(f) If the *NSP*:

(1) has reason to believe that a *generating unit* does not comply with one or more of the requirements of clause 3.3 or 3.4, as applicable;

(2) has reason to believe that a *generating unit* does not comply with the requirements for *protection schemes* set out in clause 2.6, as

those requirements apply to the *generator* under subclause 3.5.1(b); or

(3) either:

(A) does not have evidence demonstrating that a *generating unit* complies with the technical requirements set out in clause 3.3 or 3.4 as applicable; or

(B) holds the opinion that there is, or could be, a threat to the *security* or stability,

the *NSP* may direct the relevant *generator* to operate the relevant *generating unit* at a particular *generated* output or in a particular mode of operation until the relevant *generator* submits evidence reasonably satisfactory to the *NSP*, that the *generating unit* is complying with the relevant technical requirement. If such a *direction* is given orally, the *direction*, and the reasons for it, must be confirmed in writing to the *generator* as soon as practicable after the *direction* is given.

(g) If:

(1) the *NSP* gives a *direction* to a *generator* under subclause 4.1.3(e) and the *generator* neglects or fails to comply with that *direction*; or

(2) the *NSP* endeavours to communicate with a *generator* for the purpose of giving a *direction* to a *generator* under subclause 4.1.3(e) but is unable to do so within a time which is reasonable, having regard for circumstances giving rise to the need for the *direction*,

then the *NSP* may take such measures as are available to it to cause the relevant *generating unit* to be operated at the required *generated* output or in the required mode, or *disconnect* the *generating unit* from the *power system.*

(h) A *direction* under subclause 4.1.3(e) must be recorded by the *NSP*.

(i) From the *Rules commencement date*, each *generator* must maintain records and retain them for a minimum of 7 years (from the date of creation of each record) for each of its *generating units* and *power stations* setting out details of the results of all technical performance and monitoring conducted under this clause 4.1.3 and make these records available to the *NSP* on request.

4.1.4 Routine testing of protection equipment

(a) A *controller* must cooperate with the *NSP* to test the operation of *equipment* forming part of a *protection scheme* relating to a *connection point* at which that *controller* is *connected* to a *network* and the *controller* must conduct these tests:

(1) prior to the *equipment* at the relevant *connection point* being placed in service; and

(2) at intervals specified in the *access contract* or in accordance with an asset management plan agreed between the *NSP* and the *controller*.

(b) A *controller* must, on request from the *NSP*, demonstrate to the *NSP's* satisfaction the correct calibration and operation of the *controller's protection* at the *controller's connection point*.

(c) The *NSP* and, where applicable, a *controller*, must institute and maintain a compliance program to ensure that each of its facilities of the following types, to the extent that the proper operation of any such *facility* may affect *security* and the ability of the *power system* to meet the performance standards specified in clause 2.2, operates reliably and in accordance with its relevant performance requirements specified in chapter 2:

(1) *protection systems*;

(2) *control systems* for maintaining or enhancing *power system stability*;

(3) *control systems* for controlling voltage or *reactive power*; and

(4) *control systems* for *load shedding*.

(d) A compliance program under subclause 4.1.4(c) must:

(1) include monitoring of the performance of the facilities;

(2) to the extent reasonably necessary, include provision of periodic testing of the performance of those facilities upon *security* depends;

(3) provide reasonable assurance of ongoing compliance of the *power system* with the performance standards specified in clause 2.2; and

(4) be in accordance with good electricity industry practice.

(e) A *controller* must notify the *NSP* and the *ISO*, and an *NSP* must notify the *ISO*, immediately if it reasonably believes that a *facility* of the type listed in subclause 4.1.4(c), and forming part of a *registered facility*, does not comply with, or is unlikely to comply with, relevant performance requirements specified in chapter 2.

4.1.5 Testing by controllers of their own equipment requiring changes to agreed operation

(a) If a *controller* proposes to conduct a test on *equipment* related to a *connection point* and that test requires a *change* to the operation of that *equipment* as specified in the relevant *access contract*, or if the *controller* reasonably believes that the test might have an impact on the operation or performance of the *power system*, the *controller* must give notice in writing to the *NSP* at least 15 *business days* in advance of the test, except in an emergency.

(b) The notice to be provided under subclause 4.1.5(a) must include:

(1) the nature of the proposed test;

(2) the estimated start and finish time for the proposed test;

(3) the identity of the *equipment* to be tested;

(4) the *power system* conditions required for the conduct of the proposed test;

(5) details of any potential adverse consequences of the proposed test on the *equipment* to be tested;

(6) details of any potential adverse consequences of the proposed test on the *power system*; and

(7) the name of the person responsible for the coordination of the proposed test on behalf of the *controller*.

(c) The *NSP* must review the proposed test to determine whether the test:

(1) could adversely affect the normal operation of the *power system*;

(2) could cause a threat to *security*;

(3) requires the *power system* to be operated in a particular way which differs from the way in which the *power system* is normally operated;

(4) could affect the normal metering of *energy* at a *connection point*;

(5) could threaten public safety; or

(6) could damage equipment at the connection point.

(d) If, in the *NSP's* or the *ISO's* opinion, a test could threaten public safety, damage or threaten to damage *equipment* or adversely affect the operation, performance or *security* of the *power system*, the *NSP* or the *ISO,* as the case may be, may direct that the proposed test procedure be modified or that the test not be conducted at the time proposed.

(e) The *NSP* must advise any other *controllers* who will be adversely affected by a proposed test and consider any requirements of those *controllers* when approving the proposed test.

(f) The *controller* who conducts a test under this clause 4.1.5 must ensure that the person responsible for the coordination of the test promptly advises the *NSP* and the *ISO* when the test is complete.

(g) If the *NSP* approves a proposed test, the *NSP* must ensure that *power system* conditions reasonably required for that test are provided as close as is reasonably practicable to the proposed start time of the test and continue for the proposed duration of the test.

(h) Within a reasonable period after any such test has been conducted, the *controller* who has conducted a test under this clause 4.1.5 must provide the *NSP* with a report in relation to that test, including test results where appropriate.

4.1.6 Tests of generating units requiring changes to agreed operation

(a) The *NSP* may, at intervals of not less than 12 *months* per *generating unit*, by notice to the relevant *generator* accordingly, require the testing of any *generating unit connected* to the *network* in order to determine analytic parameters for modelling purposes or to assess the performance of the relevant *generating unit*.

(b) The *NSP* must, in consultation with the *generator*, propose a date and time for the tests but, if the *NSP* and the *generator* are unable to agree on a date and time for the tests, they must be conducted on the date and at the time nominated by the *NSP*, provided that:

(1) the tests must not be scheduled for a date earlier than 15 *business days* after notice is given by the *NSP* under subclause 4.1.6(a);

(2) the *NSP* must ensure that the tests are conducted at the next scheduled *outage* of the relevant *generating unit* or at some other time which will minimise the departure from the *commitment* and *dispatch* that is anticipated to take place at that time; and

(3) in any event, the tests must be conducted no later than 9 *months* after notice is given by the *NSP* under subclause 4.1.6(a).

(c) A *generator* must provide any reasonable assistance requested by the *NSP* in relation to the conduct of the tests.

(d) Tests conducted under clause 4.1.6 must be conducted in accordance with test procedures agreed between the *NSP* and the relevant *generator*. A *generator* must not unreasonably withhold its agreement to test procedures proposed for this purpose by the *NSP*.

(e) The *NSP* must provide to a *generator* such details of the analytic parameters of the model derived from the tests referred to in clause 4.1.6 for any of that *generator's generating units* as may reasonably be requested by the *generator*.

4.1.7 Power system tests

(a) Tests conducted for the purpose of either verifying the magnitude of the *power transfer capability* of the *network* or investigating *power system* performance must be coordinated and approved by the *NSP*.

(b) The tests described in subclause 4.1.7(a) may be *directed* by the *NSP*, the *ISO* or by a *controller*, whenever:

(1) a new *generating unit* or *facility* or a *network* development is commissioned that is calculated or anticipated to alter substantially the *power transfer capability* through the *network*;

(2) setting changes are made to any turbine control system and excitation control system, including power system stabilisers; or

(3) they are required to verify the performance of the *power system* or to validate computer models.

(c) Unless the *ISO* determines otherwise, tests as described in subclause 4.1.7(a) must be conducted by the *NSP* when requested under subclause 4.1.7(b).

(d) The *NSP* must notify all *controllers* who could reasonably be expected to be affected by the proposed test at least 15 *business days* before any test under this clause 4.1.7 may proceed and consider any requirements of those *controllers* when approving the proposed test.

(e) Operational conditions for each test must be arranged by the *NSP* and the test procedures must be coordinated by an officer nominated by the *NSP* who has authority to stop the test or any part of it or vary the procedure within pre-approved guidelines if it considers any of these actions to be reasonably necessary.

(f) A *controller* must cooperate with the *NSP* when required in planning and conducting *transmission* and *distribution system* tests as described in subclause 4.1.7(a).

(g) The *NSP* may direct the operation of *generating units* by *controllers* during *power system* tests and, where necessary, the *disconnection* of *generating units* from the *network*, if this is necessary to achieve operational conditions on the *network* which are reasonably required to achieve valid test results.

(h) The *NSP* must plan the timing of tests so that the variation from *commitment* and *dispatch* that would otherwise occur is minimised and the duration of the tests is as short as possible consistent with test requirements and *security*.

4.2 Commissioning of controller's equipment

4.2.1 Requirement to inspect and test equipment

(a) A *controller* must ensure that new or replacement *equipment* is inspected and tested to demonstrate that it complies with relevant Australian Standards, relevant international standards, these *Rules*, the ENAC or *PNAC* (as applicable), and any relevant *access contract* and *good electricity industry practice* prior to being *connected* to a *network*.

(b) If a *controller* installs or replaces *equipment* at a *connection point*, the *NSP* is entitled to witness the inspections and tests described in subclause 4.1.1(a).

4.2.2 Co-ordination during commissioning

(a) A *controller* seeking to connect *equipment* to a *network* must cooperate with the *NSP* to develop procedures to ensure that the commissioning of the connection and *connected facility* is carried out in a manner that:

(1) does not adversely affect other *controllers* or affect *security* or *quality of supply* of the *power system*; and

(2) minimises the threat of damage to the *NSP's* or any other *controller's equipment*.

(b) A *controller* may request from the *NSP* to schedule commissioning and tests (including the relevant exchange of correspondence) at particular times that suit the project completion dates. The *NSP* must make all reasonable efforts to accommodate such a request.

(c) A *controller* must not connect *equipment* to the *network* without the approval of the *NSP* who must not approve such connection before the *controller's* installation has been certified for compliance with these *Rules* and the *WA Electrical Requirements*. To avoid doubt, subclause 4.2.2(c) does not apply if clause 3.5 applies.

4.2.3 Control and protection settings for equipment

(a) Not used.

(b) Not less than 65 *business days* (or as otherwise agreed between the *controller* and the *NSP*) prior to the proposed commencement of commissioning by a *controller* of any new or replacement *equipment* that could reasonably be expected to alter materially the performance of the *power system*, the *controller* must submit to the *NSP* sufficient design information including proposed parameter settings to allow critical assessment including analytical modelling of the effect of the new or replacement *equipment* on the performance of the *power system*.

(c) The *NSP* must:

(1) consult with other *controllers* as appropriate; and

(2) within 20 *business days* of receipt of the design information under subclause 4.2.3(a), notify the *controller* of any comments on the proposed parameter settings for the new or replacement *equipment*.

(d) If the *NSP's* comments include alternative parameter settings for the new or replacement *equipment*, then the *controller* must notify the *NSP* within 10 *business days* that it either accepts or disagrees with the alternative parameter settings suggested by the *NSP*.

(e) The *NSP* and the *controller* must negotiate parameter settings that are acceptable to them both.

(f) The *controller* and the *NSP* must co-operate with each other to ensure that adequate grading of *protection* is achieved so that faults within the *controller's facility* are cleared without adverse effects on the *power system*.

4.2.4 Commissioning program

(a) Not less than 65 *business days* (or as otherwise agreed between the *controller* and the *NSP*) prior to the proposed commencement of commissioning by a *controller* of any new or replacement *equipment* that could reasonably be expected to alter materially the performance of the *power system*, the *controller* must advise the *NSP* and the *ISO* in writing of the commissioning program including test procedures and proposed test *equipment* to be used in the commissioning.

(b) The *NSP* must, within 20 *business days* of receipt of such advice under subclause 4.2.4(a), notify the *controller* either that it:

(1) agrees with the proposed commissioning program and test procedures; or

(2) requires *changes* in the interest of maintaining *security*, safety or *quality of supply*.

(c) If the *NSP* or the *ISO* requires *changes*, then the *NSP* and the *controller* must cooperate to reach agreement and finalise the commissioning program within a reasonable period.

(d) A *controller* must not commence the commissioning until the commissioning program has been finalised and the *NSP* must not unreasonably delay finalising a commissioning program.

4.2.5 Commissioning tests

(a) The *NSP* and the *ISO* have the right to witness commissioning tests relating to new or replacement *equipment* including *remote monitoring equipment*, *protection* and control and data acquisition *equipment*, that could reasonably be expected to alter materially the performance of the *power system* or the accurate metering of *energy* or be required for the real time operation of the *power system*.

(b) Prior to connection to the *network* of new or replacement *equipment* covered by subclause 4.2.5(a), a *controller* must provide to the *NSP* and the *ISO* a signed written statement to certify that the inspection and tests required under subclause 4.2.1(a) have been completed and that the *equipment* is ready to be *connected* and energised. The statement must be certified by a Chartered Professional Engineer with National Professional Engineers' Register Standing, qualified in a relevant discipline.

(c) The *NSP* must, within a reasonable period of receiving advice of commissioning tests of a *controller's* new or replacement *equipment* under this clause 4.2.5, advise the *controller* whether or not it:

(1) wishes to witness the commissioning tests; and

(2) agrees with the proposed commissioning times.

(d) A *controller* whose new or replacement *equipment* is tested under this clause must, as soon as practicable after the completion of the relevant tests, submit to the *NSP* and the *ISO* the commissioning test results demonstrating that a new or replacement item of *equipment* complies with these *Rules* or the relevant *access contract* or both.

(e) If the commissioning tests conducted under this clause in relation to a *controller's* new or replacement item of *equipment* demonstrate noncompliance with one or more requirements of these *Rules* or the relevant *access contract*, then the *controller* must promptly meet with the *NSP* to agree on a process aimed at achieving compliance with the relevant item in these *Rules*.

(f) The *NSP* or the *ISO* may direct that the commissioning and subsequent connection of a *controller's equipment* must not proceed if the relevant *equipment* does not meet the technical requirements specified in clause 4.2.

(g) All commissioning tests under this clause must be carried out under the supervision of personnel experienced in the commissioning of *power system primary equipment* and *secondary equipment*.

4.2.6 Coordination of protection settings

(a) A *controller* must ensure that its *protection* settings coordinate with the existing *protection* settings of the *transmission* and *distribution system*. Where this is not possible, the *controller* may propose revised *protection* settings, for the *transmission* and *distribution system* to the *NSP*. In extreme situations it may be necessary for a *controller* to propose a commercial arrangement to the *NSP* to modify the *network protection*. The *NSP* must consider all such proposals but it must not approve a *controller's protection system* until *protection* coordination problems have been resolved. In some situations, the *controller* may be required to revise the *NSP* settings or upgrade the *NSP* or other *controllers' equipment*, or both.

(b) If a controller seeks approval from the *NSP* to apply or *change* a control or *protection system* setting, this approval must not be withheld unless the *NSP* reasonably determines that the *changed* setting would cause the *controller* not to comply with the requirements of chapter 3 of these *Rules*, or the *power system* not to comply with the performance standards specified in clause 2.2, or the *NSP* or some other *controller* not to comply with their own *protection* requirements specified in the respective clauses 2.6 and 3.5, or the *power transfer capability* of the *network* to be reduced.

(c) If the *NSP* reasonably determines that a setting of a *controller's control system* or *protection system* needs to *change* in order for the *controller* to comply with the requirements of chapter 3 of these *Rules*, or for the *power system* to meet the performance standards specified in clause 2.2, or so as not to cause the *NSP* or some other *controller* to fail to comply with its own *protection* requirements specified in clause 2.6 or 3.5, as applicable, or for the *power transfer capability* of the *network* to be restored, the *NSP* and the *controller* may agree that a new setting be applied.

(d) The *NSP* may require a test in accordance with clause 4.1.3 to verify the performance of the *controller's equipment* with any new setting.

4.2.7 Approval of proposed protection

(a) A *controller* must not allow a *consumer facility* to take *supply* of electricity from the *power system* without prior approval of the *NSP*, which must be provided promptly and without conditions if the *facility* complies with these *rules*.

(b) A *controller* must not *change* the approved *protection* design or settings without prior written approval of the *NSP*, which must be provided promptly and without conditions if the *facility* complies with these *rules*.

4.3 Disconnection and reconnection

4.3.1 General

(a) If the *NSP*, in its opinion, needs to interrupt *supply* to any *controller* of the transmission *system* for reasons of safety to the public, the *NSP's* personnel, any *controllers' equipment* or the *NSP's equipment*, the *NSP* must (time permitting) consult with the relevant *controller* prior to executing that interruption. Such consultations are generally impracticable at the *distribution system* level, because of the large number of *controllers* involved, and hence are not required in relation to interruptions to *supply* to *controllers* on the *distribution system*.

(b) The *NSP* may *disconnect controllers* if the *network* is operating outside the permissible limits.

4.3.2 Voluntary disconnection

(a) Unless agreed otherwise and specified in an *access contract*, a *controller* must give to the *NSP* notice in writing of its intention to *disconnect* a *facility* permanently from a *connection point*.

(b) A *controller* is entitled, subject to the terms of the relevant *access contract*, to require voluntary permanent *disconnection* of its *equipment* from the *power system*, in which case appropriate operating procedures necessary to ensure that the *disconnection* will not threaten *security* must be implemented in accordance with clause 4.3.3.

4.3.3 Disconnecting procedures

(a) If a *controller's facility* is to be *disconnected* permanently from the *power system*, whether in accordance with clause 4.3.2 or otherwise, the *NSP* and the *controller* must, prior to such *disconnection* occurring, follow agreed procedures for *disconnection*.

(b) The *NSP* must notify the *ISO* and other *controllers* if it reasonably believes that any of the *controllers'* rights under an *access contract* will be adversely affected by the implementation of the procedures for *disconnection* agreed under subclause 4.3.3(a). The *NSP* and the *controller* and, where applicable, other affected *controllers* must negotiate any amendments to the procedures for *disconnection* or the relevant *access contracts* that may be required.

(c) Any *disconnection* procedures agreed to or determined under subclause 4.3.3(a) must be followed by the *NSP* and all relevant *controllers*.

4.3.4 Involuntary disconnection

(a) The *NSP* may, and the *ISO* may direct an *NSP* to, *disconnect* a *controller's* facilities from the *network* or otherwise curtail the provision of services in respect of a *connection point*:

(1) whenever these rules, the *Pilbara networks rules* or another law permit the *ISO* to direct the *NSP* to do so;

(2) in accordance with subclause 4.1.3(f);

(3) in accordance with clause 4.3.5;

(4) during an emergency in accordance with clause 4.3.6; or

(5) for safety reasons where the *NSP* considers that the connection of the *controller's* facilities may create a serious hazard to people or property;

(6) in accordance with the provisions of any *Act* or Regulation; or

(7) in accordance with the controller's *access contract*.

{Note: *Disconnection* in accordance with subclause 4.3.4(a)(5) could occur, for example, if the *NSP* becomes aware that *a controller's* earthing arrangements have been *changed* to the extent that they may no longer meet the requirements of subclause 3.6.8(e).”

(b) In the case of a *disconnection* by the *NSP* during an emergency in accordance with clause 4.3.6, unless the disconnection was directed by the *ISO*, the *NSP* must provide a report to the *ISO* and the *controller* advising of the circumstances requiring such action.

4.3.5 Curtailment to undertake works

(a) The *NSP* may, in accordance with *good electricity industry practice*, *disconnect* a *controller's* facilities from the *network* or otherwise curtail the provision of services in respect of a *connection point* (collectively in this subclause 4.3.5(a) “curtailment”):

(1) to carry out planned *augmentation* or maintenance to the *network*; or

(2) to carry out unplanned maintenance to the *network* where the *NSP* considers it necessary to do so to avoid injury to any person or material damage to any property or the environment; or

(3) if there is a breakdown of, or damage to, the *network* that affects the *NSP's* ability to provide services at that *connection point*; or

(4) if an event:

(A) that is outside the reasonable control of the *NSP*; and

(B) whose effect on the assets of the *NSP* or the property of any person cannot, by employing *good electricity industry practice*, be prevented,

is imminent, with the result that safety requirements or the need to protect the assets of the *NSP* or any other property so require; or

(5) to the extent necessary for the *NSP* to comply with a *written law*.

(b) The *NSP* must keep the extent and duration of any curtailment under subclause 4.3.5(a) to the minimum reasonably required in accordance with *good electricity industry practice*.

(c) The *NSP* must notify each *controller* of the *transmission system* who will or may be adversely affected by any proposed curtailment under subclause 4.3.5(a) of that proposed curtailment as soon as practicable. Where it is not reasonably practicable to notify a *controller* prior to the commencement of the curtailment, the *NSP* must do so as soon as reasonably practicable after its commencement.

(d) If the *NSP* notifies a *controller* of a curtailment in accordance with subclause 4.3.5(c) in respect of a *connection point*, the *controller* (acting reasonably and prudently) must comply with any requirements set out in the notice concerning the curtailment.

4.3.6 Disconnection during an emergency

Where the *NSP* is of the opinion that it must (or the *ISO* is of the opinion that the *NSP* must) *disconnect* a *controller's* facilities during an emergency under these *Rules* or otherwise, then the *NSP* may (or the *ISO* may direct the *NSP* to):

(a) request the relevant *controller* to reduce the *power transfer* at the proposed point of *disconnection* to zero in an orderly manner and then *disconnect* the *controller's facility* by automatic or manual means; or

(b) immediately *disconnect* the *controller's* facilities by automatic or manual means where, in the opinion of the *NSP* or the *ISO,* as applicable, it is not appropriate to follow the procedure set out in subclause 4.3.6(a) because action is urgently required as a result of a threat to safety of persons, hazard to *equipment* or a threat to *security*.

4.3.7 Obligation to reconnect

The *NSP* must reconnect a *controller's facilities* to a *network* as soon as practicable:

(a) if the breach of these *Rules* or an *access contract* giving rise to the *disconnection* has been remedied; or

(b) if the *controller* has taken all necessary steps to prevent the re occurrence of the relevant breach and has delivered binding undertakings to the *NSP* (and, if applicable, the *ISO*) that the breach will not re-occur.

5 Network operation and coordination

5.1 Outline

{Outline of this Chapter: This chapter sets out *NSP's* and *controllers'* obligations relating to operation and coordination ***within the NSP network***. Operation and coordination of the ***wider power system*** (i.e. the NWIS or other *power system*) is managed under the *rules*. The *rules'* system-wide obligations will prevail where necessary.

This Chapter aims:

1. to establish processes and arrangements to enable the *NSP* to plan, coordinate and conduct operations within its own *network*; and
2. to establish arrangements for the actual *dispatch* of *generating units* and *loads* by *controllers* within its own *network*.}

5.2 Power system operation co-ordination responsibilities and obligations

5.2.1 NSP's responsibilities in respect of its own network

Subject to any requirement of the *Pilbara networks rules* relating to *security*, or any direction by the *ISO* or its delegate, the *NSP's* responsibilities in respect of its own *network* are:

(a) to operate its network in accordance with the law (including the *Pilbara networks rules* and these *rules*), and (subject to the foregoing and any *access contract*) the appropriate *power system operating procedures*, *network operating standards* and *good electricity industry practice*;

(b) to take steps to coordinate *medium voltage* switching procedures and arrangements within its *network* in accordance with *good electricity industry practice* in order to avoid damage to *equipment* and to ensure the safety and *reliability* of the *network*;

(c) to operate all *equipment* under its control or co-ordination within the *equipment limits* and *security limits*, wherever practicable in accordance with *GEIP*;

(d) to assess the impacts of any technical and operational *constraints* of all plant and *equipment connected* to the *network* on the operation of the *power system*;

(e) as permitted and required under the *Pilbara networks rules*, to *disconnect controller's equipment* during emergency situations to facilitate the returning the *power system* to being *inside the technical envelope*;

(f) as permitted and required under the *Pilbara networks rules*, to coordinate and direct any rotation of *supply* interruptions in the event of a major *supply* shortfall or disruption; and

(g) to investigate and review all major operational incidents in its *network* and to initiate action plans to manage any abnormal situations or significant deficiencies which could reasonably threaten safe and *reliable* operation of the *network*. Such situations or deficiencies include:

(1) frequencies outside those specified in the definition of normal operating state;

(2) *power system voltages* outside those specified in the definition of normal operating state;

(3) actual or potential *power system* instability; and

(4) unplanned or unexpected operation of major *network equipment*.

(h) as required by the *ISO*, to participate in any *ISO* investigation or review of any *power system* incident, and as directed by the *ISO* participate in the development and implementation of the *ISO's* action plans for the *power system*, to manage any abnormal situations or significant deficiencies which could reasonably threaten safe and reliable operation of the *power system*.

5.2.2 NSP's obligations in respect of system performance standards

Subject to the *Pilbara networks rules*, the *NSP* must operate those parts of the *transmission* and *distribution system* so as to ensure that the system performance standards as specified in clause 2.2.2 are met.

5.2.3 Controller obligations

(a) A *controller* must ensure that only appropriately qualified and competent persons operate *equipment* that is directly *connected* to the *network* through a *connection point*.

(b) A *controller* must co-operate with any review of operating incidents undertaken by the *NSP* under clause 5.6.3.

(c) A *controller* must co-operate with and assist the *NSP* and the *ISO* (and, if applicable, its *delegate*) in the proper discharge of the *power system* operation and co-ordination responsibilities.

(d) A *controller* must operate its facilities and *equipment* in accordance with law (including the *Pilbara networks rules* and these *rules*), and (subject to the foregoing and any *access contract*) *good electricity industry practice*.

(e) A *controller* must notify the *NSP*, prior to a *generating unit* being operated in a mode (e.g. "turbine-follow" mode) where the *generating unit* will be unable to respond in accordance with clause 3.3.4.4.

(f) Except in an emergency, a *controller* must notify the *NSP* at least 5 *business days* prior to taking *protection* of *transmission* plant out of service.

(g) Except in an emergency, a *controller* must notify the *NSP* at least 5 *business days* prior to taking *protection* of *distribution* plant out of service if this *protection* is required to meet a *critical fault clearance time*.

5.3 Control of transmission and distribution system voltages

5.3.1 Transmission and distribution system voltage control

(a) The *NSP* must determine the adequacy of its *network's* capacity to produce or absorb *reactive power* in the control of the *transmission* and *distribution system voltages*.

(b) The *NSP* must assess and determine the limits of the operation of its *transmission* and *distribution system* associated with the avoidance of *voltage* failure or collapse under *contingency event* scenarios. Any such determination must include a review of the *voltage* stability of the *NSP's transmission system*, and (in consultation with the *ISO*) the *power system*.

(c) The limits of operation of the *NSP's transmission system* must be translated by the *NSP* into key location operational *voltage* settings or limits, *transmission line* capacity limits, *reactive power* production (or absorption) capacity or other appropriate limits to enable their use by the *NSP* within its *network* to contribute to the maintenance of *security*.

(d) The *NSP* must design and construct its *transmission* and *distribution system* such that *voltage* nominations at all *connection points* within its *network* can be maintained in accordance with the technical requirements specified in chapter 2.

(e) In order to meet the requirements of subclause 5.3.1(d), the *NSP* must arrange the provision of *reactive power* facilities and *power system voltage* stabilising facilities through:

(1) appropriate contractual arrangements for reactive power support; and

(2) obligations on the part of *controllers* under relevant *access contracts*; and

(3) provision of such facilities by the *NSP*.

(f) *Reactive power* facilities arranged under subclause 5.3.1(e) may include any one or more of:

(1) synchronous generating unit voltage controls usually associated with tap-changing transformers; or generating unit AVR set point control (rotor current adjustment);

(2) synchronous condensers (compensators);

(3) static VAr compensators (SVC);

(4) static synchronous compensators (STATCOM);

(5) shunt capacitors;

(6) shunt reactors; and

(7) series capacitors.

5.3.2 Reactive power reserve requirements

The *NSP* must ensure that it has access to sufficient *reactive power reserve* at all times to maintain or restore its *network* to a normal operating state *to* satisfy its *reactive power reserve* obligations as determined under the *Pilbara networks rules*.

5.3.3 [not used]

5.4 Protection of power system equipment

5.4.1 Power system fault levels

(a) The *NSP* must determine the maximum prospective fault levels at all *transmission system busbars* and all *zone substation supply busbars* within its *network*. This determination must consider all credible *transmission system* operating configurations and all credible *generation* patterns, but need not consider short term switching arrangements that result in, for example, the temporary paralleling of *transformers* to maintain continuity of *supply*.

(b) The *NSP* must provide the fault levels determined under subclause 5.4.1(a) to a *controller*, on request, and other information as necessary to allow the *controller* to determine the maximum fault level at any of the *controller's connection points* within its *network*.

5.4.2 Audit and testing

The *NSP* must coordinate such inspections and tests as the *NSP* thinks appropriate to ensure that the *protection* of its *transmission and distribution system* is adequate to protect against damage to *power system equipment* and *equipment*. Such tests must be performed according to the requirements of clause 4.1.

5.4.3 Power Transfer limits

The *NSP* must not exceed the *power transfer* limits specified in clause 2.3.8, and must not require or recommend action which causes those limits to be exceeded.

5.4.4 Partial outage of power protection systems

(a) Where there is an *outage* of one *protection scheme* of a *transmission element*, the *NSP* must determine the most appropriate action to take to deal with that *outage*. Depending on the circumstances, the *NSP's* determination may be:

(1) to leave the *transmission element* in service for a limited duration;

(2) to take the *transmission element* out of service immediately;

(3) to install or direct the installation of a temporary *protection scheme*;

(4) to accept a degraded performance from the *protection system*, with or without additional operational measures or other temporary measures to minimise impact to its *network*; or

(5) to operate the *transmission element* at a lower capacity.

(b) If there is an *outage* of both *protections* on a *transmission element* and the *NSP* determines that to leave the *transmission element* in service presents an unacceptable risk to *security*, the *NSP* must take the *transmission element* out of service as soon as practicable and advise any affected *controllers* immediately this action is undertaken.

(c) Subject to these rules and the *Pilbara network rules*, a determination made by the *NSP* under this clause 5.4.4 is binding on any affected *controller*.

5.5 Power system stability coordination

5.5.1 [not used]

5.5.2 [not used]

5.6 Security operation and co-ordination

5.6.1 Controller's advice

(a) A *controller* must promptly advise the *NSP* and the *ISO* if the *controller* becomes aware of any circumstance, including any defect in, or mal-operation of, any *protection* or *control system*, which could be expected to adversely affect *security*.

(b) If the *NSP* or the *ISO* considers the circumstances advised to it under subclause 5.6.1(a) to be a threat to *security*, the *NSP* or the *ISO* may direct the *controller* to ensure that the *equipment* protected or operated by the relevant *protection* or *control system* be taken out of operation or operated in such manner as the *NSP* or the *ISO* requires.

(c) A *controller* must comply with a *direction* given by the *NSP* or the *ISO* under subclause 5.6.1(b).

5.6.2 [not used]

5.6.3 Review of network operating incidents

(a) The *NSP* may conduct reviews of significant operating incidents or deviations from normal operating conditions within its *network* in order to assess the adequacy of the provision and response of facilities or services.

(b) A *controller* of the *network* must cooperate in any such review conducted by the *NSP* (including by making available relevant records and information).

(c) A *controller* must provide to the *NSP* such information relating to the performance of its *equipment* during and after particular *power system* incidents or operating condition deviations as the *NSP* reasonably requires for the purposes of analysing or reporting on those *power system* incidents or operating condition deviations.

(d) For cases where the *NSP* has *disconnected* a *transmission system controller*, a report must be provided by the *NSP* to the *controller* detailing the circumstances that required the *NSP* to take that action.

{Note: This requirement does not apply to the *disconnection* of a *controller* from the *distribution system* due to the large number of *connection points* involved. However, for large *controllers connected* to the *distribution system*, this requirement may be included in an *access contract.}*

(e) The *NSP* must provide to a *controller* available information or reports relating to the performance of that *controller's equipment* during *power system* incidents or operating condition deviations as that *controller* requests.

5.7 Controller's operations and maintenance planning

(a) On or before 1 July and 1 January each year, a *controller*, where so requested by the *NSP*, must provide to the *NSP*:

(1) a maintenance schedule in respect of the *equipment* and *equipment connected* at each of its *connection points* for the following *financial year*; and

(2) a non-binding indicative planned maintenance plan in respect of the *equipment* and *equipment connected* at each of its *connection points* for each of the 2 *financial years* following the *financial year* to which the maintenance schedule provided under subclause 5.7(a)(1) relates.

(b) A *controller* must provide the *NSP* with any information that the *NSP* requests concerning maintenance of *equipment* and *equipment connected* at the *controller's connection points*.

(c) A *controller* must ensure that a maintenance schedule provided by the *controller* under subclause 5.7(a)(1) is complied with, unless otherwise agreed with the *NSP*.

(d) Both a maintenance schedule and a maintenance plan must:

(1) specify the dates and duration of planned *outages* for the relevant *equipment* which may have an impact on the *transmission system*;

(2) specify the work to be carried out during each such an *outage*;

(3) be in writing in substantially the form requested by the *NSP*; and

(4) be consistent with good electricity industry practice.

(e) If a *controller* becomes aware that a maintenance schedule provided by the *controller* under subclause 5.7(a)(1) in respect of one of its *connection points* will not be complied with, then the *controller* must promptly notify the *NSP*.

5.8 Operating procedures

5.8.1 Operation of controller's equipment

The *NSP* may direct a *controller* to place *reactive power* facilities belonging to, or controlled by, that *controller* into or out of service for the purposes of maintaining *power system* performance standards specified in clause 2.2. A *controller* must comply with any such *direction*.

5.9 Power system operation support

5.9.1 Remote control and monitoring devices

A *controller* must install, operate and maintain all remote control, operational metering and monitoring devices and local circuits as described in chapter 3 in accordance with the standards and protocols determined and advised under these rules.

5.9.2 Power system operational communication facilities

(a) A *controller* must advise the *NSP* of its requirements for the giving and receiving of *operational communications* in relation to each of its facilities. The requirements which must be forwarded to the *NSP* include:

(1) the title of contact position;

(2) the telephone numbers of that position;

(3) the telephone numbers of other available communication systems in relation to the relevant *facility*;

(4) a facsimile number for the relevant *facility*; and

(5) an electronic mail address for the relevant *facility*.

(b) A *controller* must maintain the speech communication channel installed in accordance with subclause 3.3.4.3(c) or subclause 3.4.9(d) in good repair and must investigate any fault within 4 hours, or as otherwise agreed with the *NSP*, of that fault being identified and must repair or procure the repair of faults promptly.

(c) Where required by the *NSP* a *controller* must establish and maintain a form of electronic mail *facility* as approved by the *NSP* for communication purposes.

(d) The *NSP* must, where necessary for the operation of the *transmission* and *distribution system*, advise *controllers* of nominated persons for the purposes of giving or receiving *operational communications*.

(e) Contact details to be provided by the *NSP* in accordance with subclause 5.9.2(d) include position, telephone numbers, a facsimile number and an electronic mail address.

5.9.3 Authority of nominated operational contacts

The *NSP* and a *controller* are each entitled to rely upon any communications given by or to a contact designated under clause 5.9.2 as having been given by or to the *controller* or the *NSP*, as the case requires.

5.9.4 Records of power system operational communication

(a) The *NSP* and *controllers* must log each telephone *operational communication* in the form of entries in a log book which provides a permanent record as soon as practicable after making or receiving the *operational communication*.

(b) In addition to the log book entry required under subclause 5.9.4(a), the *NSP* must make a voice recording of each telephone *operational communication*. The *NSP* must ensure that when a telephone conversation is being recorded under this subclause 5.9.4(b), the persons having the conversation receive an audible indication that the conversation is being recorded in accordance with relevant statutory requirements.

(c) Records of *operational communications* must include the time and content of each communication and must identify the parties to each communication.

(d) The *NSP* and *controllers* must retain all *operational communications* records including voice recordings for a minimum of 7 years.

(e) If there is a dispute involving an operational communication, the voice recordings of that operational communication maintained by, or on behalf of the *NSP* will constitute prima facie evidence of the contents of the operational communication.

5.10 Nomenclature standards

(a) A *controller* must use the *nomenclature standards* for *transmission* and *distribution equipment* and apparatus as determined by the *NSP*, and use the agreed nomenclature in any operational communications with the *NSP*.

(b) A *controller* must ensure that name plates on its *equipment* relevant to operations at any point within the *power system* conform to the agreed nomenclature and are maintained to ensure easy and accurate identification of *equipment*.

(c) A *controller* must ensure that technical drawings and documentation provided to the *NSP* comply with the agreed nomenclature.

(d) The *NSP* may, by notice in writing, require a *controller* connected to its *network* to *change* the existing numbering or nomenclature of *transmission* and *distribution equipment* and apparatus of the *controller* for purposes of uniformity.

Attachments

Attachment 1 – Process for determining the content of these Attachments

When these *Rules* require something to be specified under an Attachment, or similar language, then the following process is to be followed to develop, and publish or make available, the necessary information:

1. The NSP of a light-regulated Pilbara network:

    a must *publish* the information as part of its *User Access Guide* under the *PNAC*; and

    b must confer with the *ISO* before doing so.

2. The *NSP* of a *full-regulated Pilbara network* must include the information in its proposed Access Arrangement under the *ENAC*.

3. The *NSP* of a *non-covered network* may *publish* or otherwise make available the information as it sees fit in accordance with *GEIP*.

4. Pending any such *publication* or making-available, the corresponding Attachment of the *Horizon Power Technical Rules* of October 2020, read with appropriate amendments, may be used as a non-binding guideline.

Attachment 2 [not used]

Attachment 3 [not used]

Attachment 4 [not used]

Attachment 5 – Submission requirements for electrical plant protection

The content of Attachment 5 is to be developed, and published or made available, in accordance with Attachment 1.

Attachment 6 [not used]

Attachment 7 [not used]

Attachment 9 [not used]

Attachment 10 – Distribution system connected generators up to 10 MW (except inverter- connected generators up to 1000 kVA)

The content of Attachment 10 is to be developed, and published or made available, in accordance with Attachment 1.

Attachment 11 – Test schedule for specific performance verification and model validation

The content of Attachment 11 is to be developed, and published or made available, in accordance with Attachment 1.

Attachment 12 – Testing and commissioning of small power stations (< 10 MW) connected to the distribution system

The content of Attachment 12 is to be developed, and published or made available, in accordance with Attachment 1.

Attachment 13 [not used]

Attachment 14 [not used]

Attachment 15 [not used]

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