Jemena Electricity Networks (Vic) Ltd

Embedded Generation - Technical Access Standards

Embedded Generation - 5 MW or Greater

ELE SP 0003

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ABBREVIATIONS

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
CB	Circuit breaker
DNSP	Distribution Network Service Provider
EDC	Electricity Distribution Code
ESC	Essential Services Commission
JEN	Jemena Electricity Network
NECA	National Electricity Code Administrator
NEL	National Electricity Law
NEM	National Electricity Market
NER	National Electricity Rules
NSP	Network Service Provider
ROCOF	Rate of Change of Frequency
SIR	Service and Installation Rules
THD	Total harmonic distortion
TNSP	Transmission Network Service Provider

1. INTRODUCTION

This document provides the automatic access standards and minimum access standards related to the technical performance of embedded generation connections greater than 5 MW to the Jemena Electricity Network (JEN). The document is intended to assist proponents or their agents in understanding JEN's access requirements and form a framework for negotiations on technical issues.

JEN recommends that this document be reviewed by the proponent in conjunction with the following:

1. Embedded Generation 5 MW or Greater - Connection Principles and Guidelines (ELE GU 0004)
2. Embedded Generation 5 MW or Greater - Connection Process Description (ELE PR 0007)

For the purposes of this document, the following definitions apply –

Automatic Access Standard - In relation to a technical requirement of access, a standard of performance, identified in this document as an automatic access standard for that technical requirement, such that a plant that meets that standard would not be denied access because of that technical requirement.

Minimum Access Standard - In relation to a technical requirement of access, a standard of performance, identified in this document as a minimum access standard for that technical requirement, such that a plant that does not meet that standard will be denied access because of that technical requirement.

Negotiated Access Standard - In relation to a technical requirement of access for a particular plant, an agreed standard of performance determined in accordance with JEN's technical access negotiations process and identified as a negotiated access standard for that technical requirement in a connection agreement.

As a general principle, any term appearing in this document which is a defined term in the National Electricity Rules should be read as having that definition, unless an alternative definition appears in this document.

2. TECHNICAL ACCESS (PERFORMANCE) STANDARDS

2.1 GENERATOR SIZE - 30 MW OR GREATER

Refer to Schedule S5.2.5.5 within Chapter 5 (Network Connection, Planning and Expansion) of the National Electricity Rules found on the AEMC website - http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/Current-Rules

2.2 GENERATOR SIZE - 5 MW OR GREATER, AND LESS THAN 30 MW

2.2.1 REACTIVE POWER CAPABILITY

Automatic Standard

1. Each generating system;
2. While operating at any level of active power output; and
3. At any voltage at the connection point within the limits established under clause 3.2.4 pertaining to 'Generating System Response to Voltage Disturbances', without a contingency event,

is capable of:

1. Continuously supplying at its connection point an amount of reactive power of at least the product of the rated active power of the generating system and 0.395;
2. Continuously absorbing at its connection point an amount of reactive power of at least the product of the rated active power of the generating system and 0.395.

Minimum Standard

The minimum access standard is no capability is required to supply or absorb reactive power at the connection point.

General Requirements

A negotiated access standard under this clause shall specify the steady state reactive power import and export capability of the generating system at the connection point, as a function of the level of active power output and the connection point voltage magnitude where necessary.

The performance standard shall also nominate the normal range of reactive power import or export when the generating system operates in steady state without a contingency event, in accordance with its voltage/reactive power control scheme nominated under clause 3.2.13.

JEN may require the Generator to provide evidence by way of load flow studies that the generating system will comply with its nominated Performance Standard under this clause 3.2.1.

2.2.2 QUALITY OF ELECTRICITY GENERATED

Automatic Standard

The generating system when generating and when not generating must not produce at the point of connection:

1. Steady state low frequency voltage fluctuation and maximum relative voltage change, short term flicker and long term flicker greater than the relevant limits within AS/NZS61000.3.7:2001.
   The voltage fluctuation emission limits allocated for the generation system will be no more onerous than the lesser of the acceptance levels determined in accordance with either of the stage 1 or the stage 2 evaluation procedures defined in AS/NZS 61000.3.7:2001;

2. The harmonic voltage distortion emission limits allocated for the generation system will be no more onerous than the lesser of the acceptance levels determined in accordance with either of the stage 1 or the stage 2 evaluation procedures defined in AS/NZS 61000.3.6:2001;

3. Negative sequence current injection such that:

   a) for connection point voltage of 30 kV or higher, the current in any phase is not greater than 102 percent or less than 98 percent of the average of the currents in the three phases;

   b) for connection point voltage of less than 30 kV, the current in any phase is not greater than 105 percent or less than 95 percent of the average of the currents in the three phases; and

4. Zero sequence current measurably different from zero.

Minimum Standard

The generating system when generating and when not generating must not produce at the point of connection:

5. Steady state low frequency voltage fluctuation and maximum relative voltage change, short term flicker and long term flicker greater than the relevant limits within AS/NZS61000.3.7:2001.
   The voltage fluctuation emission limits allocated for the generation system will be undertaken in consultation with the generation system proponent in accordance with the stage 3 evaluation procedures defined in AS/NZS 61000.3.7:2001.
   The generation system may be required, if necessary to meet the system standards or allow connection of other Network Users to either upgrade to the automatic access standard or fund the reasonable cost of the works necessary to mitigate their effect of connecting at a standard below the automatic access standard.;

6. The harmonic voltage distortion emission limits allocated for the generation system will be undertaken in consultation with the generation system proponent in accordance with the stage 3 evaluation procedures defined in AS/NZS 61000.3.6:2001.
   The generation system may be required, if necessary to meet the system standards or allow connection of other Network Users to either upgrade to the automatic access standard or fund the reasonable cost of the works necessary to mitigate their effect of connecting at a standard below the automatic access standard.;

7. Negative sequence current injection such that the negative sequence voltage at the connection point is at a level of less than 1 percent.
   The negative sequence voltage may vary above 1% of an applicable voltage level, but not beyond 2% for a total of 5 minutes in every 30 minute period.

8. Zero sequence current injection to level as negotiated between the generation system and JEN.

2.2.3 GENERATING UNIT RESPONSE TO FREQUENCY DISTURBANCES

Automatic Standard

Each generating unit is capable of continuous uninterrupted operation for frequencies in the following ranges:

Table 2–1: Frequency Ranges for Continuous Operation – Automatic Standard

Frequency range (Hz)	Duration
47 to 49	2 minutes
51 to 52	2 minutes
47 to 49.5	10 minutes
50.5 to 52	10 minutes
49.5 to 50.5	continuous

unless the rate of change of frequency is outside the range of –4 Hz to 4 Hz per second for more than 0.25 seconds.

Minimum Standard

Each generating unit is capable of continuous uninterrupted operation for frequencies in the following ranges:

Table 2–2: Frequency Ranges for Continuous Operation – Minimum Standard

Frequency range (Hz)	Duration
47 to 47.5	9 seconds
47 to 49	2 minutes
47 to 49.5	10 minutes
50.5 to 52	10 minutes
49.5 to 50.5	continuous

unless the rate of change of frequency is outside the range of –1 Hz to 1 Hz per second for more than 1.0 seconds.

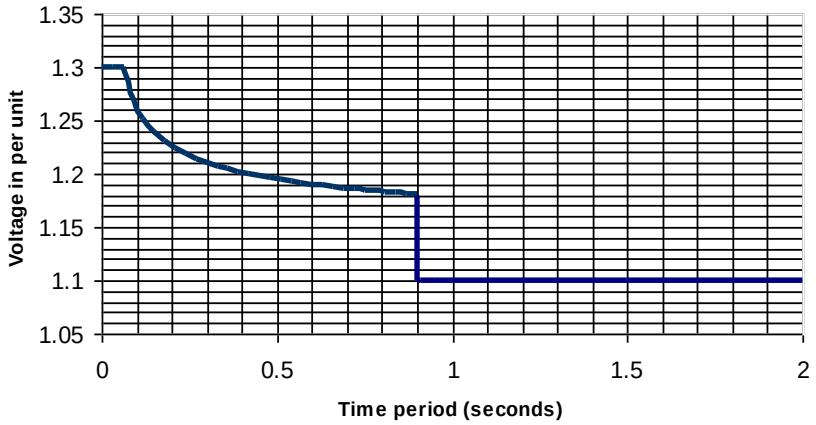
2.2.4 GENERATING UNIT RESPONSE TO VOLTAGE DISTURBANCES

Automatic Standard

This generating system and each of its generating units, when operating at any level of active and reactive power at the connection point in accordance with its capability nominated under Clause 3.2.1, is capable of continuous uninterrupted operation within the following range of voltages for the given duration at its connection point:

1. Voltages over 110% of normal voltage for the duration as permitted in the graph below

Figure 2–1: Over-voltage Range for Continuous Operation – Automatic Standard



2. 90% to 110% of normal voltage continuously;

3. 80% to 90% of normal voltage for a period of at least 10 seconds; and

4. 70% to 80% of normal voltage for a period of at least 2 seconds.

Minimum Standard

The generating system including all operating generating units must, when operating in a steady state at any level of active and reactive power output in accordance with its voltage/reactive control scheme nominated under clause 3.2.13, be capable of continuous uninterrupted operation where a power system disturbance causes the voltage at the connection point to vary in the range of 90% to 110% of normal voltage, provided that the ratio of voltage to frequency (as measured at the connection point and expressed as percentage of normal voltage and a percentage of 50 Hz) does not exceed:

1. a value of 1.15 for more than two minutes; or

2. a value of 1.10 for more than 10 minutes.

General Requirements

The normal voltage applicable at the connection point will be advised by JEN in its response to a Connection Enquiry and is to be stated in the agreed Performance Standard under this clause.

JEN may require the Generator to provide evidence by way of power system studies that the generating system will comply with its nominated Performance Standard under this clause 3.2.4.

2.2.5 GENERATING SYSTEM RESPONSE TO DISTURBANCES FOLLOWING CONTINGENCY EVENTS

For the purpose of this clause 3.2.5 the following fault clearance times apply.

Transmission system (132 kV and greater) fault clearance time:

> Primary protection system, 120 milliseconds for the nearest circuit breaker and 220 milliseconds for any remote circuit breaker that must operate to isolate the faulted circuit
> Breaker fail protection system, 430 milliseconds.

JEN will provide fault clearance times on a case by case basis for sub-transmission and distribution system faults.

Automatic Standard

1. The generation system and each of its generating units remains in continuous uninterrupted operation for a disturbance caused by an event that is:

   a) A three phase fault in a transmission system cleared by all relevant primary protection systems;

   b) A two phase to ground, phase to phase or phase to ground fault in the transmission system cleared in:

      i) the longest time expected to be taken for a relevant breaker fail protection system to clear the fault; or

      ii) if breaker fail protection system is not installed then the greater of the time specified in the table below

Table 2–3: Fault Clearance times for Breaker Fail Protection Systems

Nominal voltage at fault location (kV)	Time (milliseconds)
400kV and above	175
At least 250kV but less than 400kV	250
More than 100kV but less than 250kV	430
Less than or equal to 100kV	500

      and the longest time expected to be taken for all relevant primary protection systems to clear the fault; and

   c) a three phase, two phase to ground, phase to phase or phase to phase to ground fault in the distribution system cleared in:

      i) the longest time expected to be taken for a relevant breaker fail protection system to clear the fault; or

      ii) if breaker fail protection system is not installed, the greater of 500 milliseconds and the longest time expected to be taken for all relevant primary protection systems to clear the fault.

The above requirements exclude faults that disconnect the generating unit from the power system by removing network elements from service.

2. Subject to any changed power system conditions or energy source availability beyond the Generator's reasonable control after disconnection of the faulted element, the generation system, in respect of fault types described in (i) to (iii), will supply to or absorb from the network:

   a) capacitive reactive current of at least the greater of its pre-disturbance reactive current and 4% of the maximum continuous current of the generating system including all generating units (in the absence of a disturbance) for each 1% reduction (from its pre-fault level) of connection point voltage during the fault, up to a limit determined in accordance with the generating system's overall MVA rating;

   b) after disconnection of the faulted element, reactive power sufficient to ensure that the connection point voltage is within the range for continuous uninterrupted operation under the performance standard for clause 3.2.4; and

   c) from 100 milliseconds after disconnection of the faulted element, active power of at least 95% of the level existing just prior to the fault.

Minimum Standard

3. The generation system and each of its generating units remains in continuous uninterrupted operation for a disturbance caused by an event that is:

    a) a single phase to ground, phase to phase or two phase to ground fault in a transmission system cleared in the longest time expected to be taken for all relevant primary protection systems to clear the fault, unless AEMO and JEN agree that:

        i) the total reduction of generation in the power system due to that fault would not exceed 100 MW;

        ii) there is unlikely to be an adverse impact on quality of supply to other Network Users; and

        iii) there is unlikely to be a material adverse impact on power system security;

or unless the event is one that would disconnect the generating unit from the power system by removing network elements from service;

    b) a single phase to ground, phase to phase or two phase to ground fault in a distribution network, cleared in the longest time expected to be taken for all relevant primary protection systems to clear the fault, unless AEMO and JEN agree that:

        i) the total reduction of generation in the power system due to that fault would not exceed 100 MW;

        ii) there is unlikely to be an adverse impact on quality of supply to other Network Users; and

        iii) there is unlikely to be a material adverse impact on power system security;

or unless the event is one that would disconnect the generating unit from the power system by removing network elements from service; and

    c) In relation to (1)(i) and (ii) above, where it is agreed by AEMO and JEN that the generation system may disconnect for unstable operation, the disconnection should be in a controlled manner and protection systems shall be implemented to detect the disturbance and disconnect the generator to minimise any adverse impact on quality of supply and power system security.

4. Subject to any changed power system conditions or energy source availability beyond the Generator's reasonable control after disconnection of the faulted element, the generating system will, in respect of the types of fault described in subparagraphs (1)(i) and (ii), deliver active power to the network, and supply or absorb reactive power, sufficient to ensure that the connection point voltage is within the range for continuous uninterrupted operation agreed under clause 3.2.4.

General Requirements

JEN may require that the Generator provide evidence by way of power system dynamic studies that the generating system will comply with its nominated Performance Standard under this clause 3.2.5.

2.2.6 QUALITY OF ELECTRICITY GENERATED AND CONTINUOUS UNINTERRUPTED OPERATION

Minimum Standard

The generating system including each of its operating generating units and reactive plant, will maintain continuous uninterrupted operation for voltage fluctuation, harmonic voltage distortion and voltage unbalance at the connection point up to and including the following limits:

1. Voltage fluctuations at the connection point up to the "compatibility levels" set out in Table 1 of Australian Standard AS/NZS 61000.3.7:2001.
2. Harmonic voltage distortion at the connection point up to the “compatibility levels” defined in Table 1 of Australian Standard AS/NZS 61000.3.6:2001.
3. A negative sequence voltage at the connection point that, when measured over a 30 minute average, does not exceed 2 per cent of nominal positive sequence voltage, or an alternative percentage level agreed with JEN, whichever is lower.
4. A negative sequence voltage at the connection point that occurs at most once per hour and, when measured over a 1 minute average, does not exceed 3 per cent of nominal positive sequence voltage, or an alternative percentage level agreed with JEN, whichever is lower.

2.2.7 PARTIAL LOAD REJECTION

1. For the purposes of this clause 3.2.7 minimum load means minimum sent out generation for continuous stable operation.
2. This clause 3.2.7 does not apply to a generating system that does not incorporate one or more synchronous generating units.

Automatic access standard

Each synchronous generating unit must be capable of continuous uninterrupted operation during and following a power system load reduction of 30% from its pre-disturbance level or equivalent impact from separation of part of the power system in less than 10 seconds, provided that the loading level remains above minimum load.

Minimum access standard

Each synchronous generating unit must be capable of continuous uninterrupted operation during and following a power system load reduction of 5% or equivalent impact from separation of part of the power system in less than 10 seconds, provided that the loading level remains above minimum load.

2.2.8 PROTECTION OF GENERATING SYSTEMS FROM POWER SYSTEM DISTURBANCES

Automatic Standard

1. For a generating system or any of its generating units that is required by a Generator or Network Service Provider to be automatically disconnected from the power system in response to abnormal conditions arising from the power system, the relevant protection system or control system must not disconnect the generating system for:
   a) conditions for which it must remain in continuous uninterrupted operation; or
   b) conditions it must withstand under the agreed generator access standards.
2. A generating system that connects to a radial distribution network must detect the loss of a phase from the distribution network and trip all three phases of the connection circuit breaker within 2 seconds.
3. The generating system must incorporate a dual redundant anti-islanding protection scheme, comprising:
   a) primary protection by way of dedicated independent remote X & Y intertrip with trip supervision, such that the generating system’s main circuit breaker is opened by an intertrip signal from an upstream protection device nominated by JEN; and

b) at least one form of backup protection by way of local anti-islanding protection with RoCoF and Vector shift subject to subclause (5) below.

4. An anti-islanding protection scheme according to (3) must:

   a) have minimum and maximum operating times for the intertrip protection that are appropriately graded with all relevant network protection and control schemes, but are in any case no greater than 0.2 seconds from initiation of a signal at the upstream device;

   b) have continuous supervision to prove the integrity of all protection elements to the satisfaction of JEN and issue a signal to JEN's control centre upon failure of any single protection component; and

   c) have facilities to trip the generating system's main circuit breaker within 0.2 seconds from detection of protection failure, subject to subclause (6) below.

5. Any local anti-islanding protection element provided as backup protection within the scheme in (3) must be capable of disconnecting the generating system from the distribution network within 0.2 seconds after a power system event causes the connecting network to enter an islanded state with the voltage at the connection point within the range for continuous uninterrupted operation under clause 3.2.4 above.

6. Disconnection of the generating system due to anti-islanding protection failure under subclause 4(c) will be deferred by 24 hours provided that at least one independent primary anti-islanding protection remains in service and continuously communicates its integrity signal to JEN's control centre during that 24 hour period.

Minimum Standard

7. For a generating system or any of its generating units that is required by a Generator or Network Service Provider to be automatically disconnected from the power system in response to abnormal conditions arising from the power system, the relevant protection system or control system must not disconnect the generating system for:

   a) conditions for which it must remain in continuous uninterrupted operation; or

   b) conditions it must withstand under the agreed generator access standards.

8. A generating system that connects to a radial distribution network must detect the loss of a phase from the distribution network and trip all three phases of the connection circuit breaker within 2 seconds.

9. A generating system must be automatically disconnected by a local or remote protection scheme whenever the part of the network to which it is connected becomes permanently de-energised.

10. A generating system that connects to:

    a) a radial distribution network; or

    b) the MV bus at a zone substation; or

    c) a sub-transmission circuit with a direct Customer connection;

    must be automatically disconnected by a local or remote control scheme, operating subject to subclause (12) below, whenever the part of the network to which it is connected has been disconnected from the main transmission system, forming an island that supplies a Customer.

11. Any local anti-islanding protection element provided in full or partial satisfaction of (9) must be capable of disconnecting the generating system from the distribution network within 0.2 seconds after a power system event causes the connecting network to enter an islanded state with the voltage at the connection point within the range for continuous uninterrupted operation under clause 3.2.4 above.

12. Except as provided under (13) below, the generating system must disconnect from the network within 0.2 seconds of detection of failure of any anti-islanding protection.

13. Disconnection of the generating system in accordance with (12) will be deferred by 24 hours in the case that:

    a) The anti-islanding protection scheme incorporates multiple redundant elements;

    b) The integrity of each element is monitored to the satisfaction of JEN; and

    c) At least one independent primary anti-islanding protection remains in service and continuously communicates its integrity signal to JEN's control centre during the period in question.

General Requirements

14. A Generator is responsible for specifying an appropriate control (anti-islanding) scheme, where required in accordance with (10), as part of any Negotiated Access Standard under this clause 2.2.8.

15. An anti-islanding scheme in accordance with (10) shall incorporate local anti-islanding protection subject to (11). Notwithstanding this, a remote intertrip must be included unless:

    a) the generating system is connecting to a radial distribution feeder, and the total maximum sent out generation from all generating systems connected to the same feeder, including the generator's system, is less than 80 per cent of the minimum load assessed by JEN in its response to the Connection Enquiry; or

    b) the generating system is connecting to the MV bus at a zone substation, and the total maximum sent out generation from all generating systems connected to the zone substation and its feeders, including the generator's system, is less than 80 per cent of the minimum load assessed by JEN for that zone substation.

2.2.9 PROTECTION SYSTEMS THAT IMPACT ON POWER SYSTEM SECURITY

Automatic access standard

1. Primary protection systems must be provided to disconnect from the power system any faulted element in a generating system and in protection zones that include the connection point within the applicable fault clearance time. The following apply;

    a) Faults within the declared protection zone in the distribution system must be detected and cleared in a manner coordinated with JEN's protection systems;

    b) The fault clearance time of primary protection systems shall be as determined by a grading study with an ideal margin of 0.4 seconds;

    c) The generator must be isolated from the network within 0.2 seconds of the distribution network earth fault protection clearing an earth fault;

    d) Protection systems must be able to detect and disconnect all high impedance faults with sensitivity that is as good as or better than the existing distribution network protection and have adequate grading margin; and

    e) Each primary protection system must have sufficient redundancy ('N-1 backup') to ensure that a faulted element within its protection zone is disconnected from the power system within the applicable fault clearance time with any single protection element (including any communications facility upon which that protection system depends) out of service; and

f) Redundancy under (e) shall ensure that the risk of common mode failure is minimised through sufficient diversity in design, for example by utilising different technologies and/or manufacturers for redundant ('X' and 'Y') primary protection elements.

2. Breaker fail protection systems must be provided to clear faults that are not cleared by the circuit breakers controlled by the primary protection system within the applicable fault clearance time;

3. Backup or redundant protection shall operate to clear external network short circuit faults within the time taken for the primary network protection or within 0.5 seconds longer than the time expected if the primary generator protection had operated;

4. Sufficient monitoring of alarms is necessary either locally or remotely to ensure the generator will not operate for longer than 24 hours using a single (non-duplicated or redundant) protection system. If sufficient monitoring cannot be provided then all relay failure alarms shall result in immediate generator shutdown or tripping.

5. Proponent shall install protection systems that prevent the generation system from connecting with the JEN distribution network unless all phases of the network are energised; there is correct phase rotation at the network connection point and the generator supply is synchronised with the JEN distribution network; and

6. Embedded generators are not permitted to reclose (attempt to reconnect to the distribution network) following a loss of network supply until the voltage on the distribution network returns to the normal operating range for a duration of 1 minute.

Minimum access standard

7. Protection systems must be provided to disconnect from the power system any faulted element within a generating system and in protection zones that include the connection point within the applicable fault clearance time. The following apply;

   a) Faults within the declared protection zone in the distribution system must be detected and cleared in a manner coordinated with JEN's protection systems;

   b) The fault clearance time of primary protection systems shall be as determined by a grading study with a margin as negotiated with JEN; and

   c) Protection systems must be able to detect and disconnect all high impedance faults with sensitivity that is as good as or better than the existing distribution network protection and have adequate grading.

8. Backup or redundant protection shall operate to clear external network short circuit faults within the time as negotiated with JEN;

9. Sufficient monitoring of alarms is necessary either locally or remotely to ensure the generator will not operate for longer than 24 hours using a single (non-duplicated or redundant) protection system. If sufficient monitoring cannot be provided then all relay failure alarms shall result in immediate generator shutdown or tripping;

10. Proponent shall install protection systems that prevent the generation system from connecting with the JEN distribution network unless all phases of the network are energised; there is correct phase rotation at the network connection point and the generator supply is synchronised with the JEN distribution network; and

11. Embedded generators are not permitted to reclose (attempt to reconnect to the distribution network) following a loss of network supply until the voltage on the distribution network returns to the normal operating range for a duration of 1 minute.

2.2.10 PROTECTION TO TRIP PLANT FOR UNSTABLE OPERATION

Automatic access standard

1. A synchronous generating unit must have a protection system to disconnect it promptly when a condition that would lead to pole slipping is detected in order to prevent pole slipping or other conditions where a generating unit causes active power, reactive power or voltage at the connection point to become unstable as assessed in accordance with the power system stability guidelines established under clause 4.3.4(h) of the NER; and
2. An asynchronous generating unit must have a protection system to disconnect it promptly for conditions where the active power, reactive power or voltage at the connection point becomes unstable as assessed in accordance with the guidelines for power system stability established under clause 4.3.4(h) of the NER.

Minimum access standard

A generating unit must not cause a voltage disturbance at the connection point due to sustained unstable behaviour of more than the maximum level specified in Table 7 of Australian Standard AS/NZS 61000.3.7:2001.

2.2.11 FREQUENCY CONTROL

Automatic access standard

1. A generating system's active power transfer to the power system must not:
   a) increase in response to a rise in system frequency; or
   b) decrease in response to a fall in system frequency; and
2. A generating system must have a governor system, or control system with equivalent functionality, that is responsive to system frequency and increases power output as frequency drops and reduces power output as frequency increases.
3. Each control system used to satisfy this access standard must be adequately damped.

Minimum access standard

4. A generating system's active power transfer to the power system, when operating under relatively stable input energy and subject to reasonable measurement limitations, must not:
   a) increase in response to a rise in system frequency; or
   b) decrease more than 2% per Hz in response to a fall in system frequency.
5. Each control system used to satisfy this access standard must be adequately damped.

General Requirements

JEN may require evidence by way of dynamic simulation results that the generating system complies with its Performance Standard under this clause 3.2.11.

2.2.12 IMPACT ON NETWORK CAPABILITY

Automatic access standard

A generating system must have plant capabilities and control systems that are sufficient so that when connected,

1. it does not reduce any inter-regional or intra-regional power transfer capability below the level that would apply if the generating system were not connected; and
2. it does not adversely impact the quality of supply and performance of any of customers connected to the distribution system.

Minimum access standard

A generating system must have plant capabilities, control systems and operational arrangements sufficient to ensure there is no reduction in:

3. the ability to supply Customer load as a result of a reduction in power transfer capability; and
4. power transfer capabilities into a region by more than its sent out generation at the connection point.

2.2.13 VOLTAGE AND REACTIVE POWER CONTROL

Automatic access standard

1. A generating system must have plant capabilities and control systems sufficient to ensure that:
   a) power system oscillations, for the frequencies of oscillation of the generating unit against any other generating unit, are adequately damped;
   b) operation of the generating system does not degrade the damping of any critical mode of oscillation of the power system; and
   c) operation of the generating system does not cause instability (including hunting of tap-changing transformer control systems) that would adversely impact other Registered Participants;
2. A control system must have:
   a) for the purposes of disturbance monitoring and testing, permanently installed and operational, monitoring and recording facilities for key variables including each input and output; and
   b) facilities for testing the control system sufficient to establish its dynamic operational characteristics;
3. A generating system must have a documented voltage/reactive control scheme (including, for any synchronous generating unit, an excitation control system that incorporates a power system stabiliser) that:
   a) regulates voltage at the connection point or another agreed location in the power system (including within the generating system) to within 0.5% of its setpoint;
   b) regulates voltage in a manner that helps to support network voltages during faults;
   c) allows the voltage setpoint to be continuously controllable in the range of at least 95% to 105% of normal voltage at the connection point or the agreed location, without reliance on a tap-changing transformer;
   d) has limiting devices to ensure that a voltage disturbance does not cause any generating unit to trip at the limits of its operating capability;

e) with the generating system connected to the power system, has settling times for active power, reactive power and voltage due to a step change of voltage setpoint or voltage at the location agreed under clause subparagraph (i), of less than:

i) 5.0 seconds for a 5% voltage disturbance with the generating system connected to the power system, from an operating point where the voltage disturbance would not cause any limiting device to operate; and

ii) 7.5 seconds for a 5% voltage disturbance with the generating system connected to the power system, when operating into any limiting device from an operating point where a voltage disturbance of 2.5% would just cause the limiting device to operate.

Minimum access standard

4. A generating system must have plant capabilities and control systems, including, if appropriate, a power system stabiliser or control system with analogous functionality, sufficient to ensure that:

a) power system oscillations, for the frequencies of oscillation of a generating unit electrically coupled with any other generating unit, are adequately damped; and

b) operation of the generating unit does not cause instability (including hunting of tap-changing transformer control systems) that would adversely impact other Registered Participants.

5. A generating unit or generating system must have a documented voltage/reactive control scheme that regulates at least one of voltage, reactive power flow, or power factor, at the connection point or another agreed location in the power system (including within the generating system).

General requirements

A functional description of the voltage/reactive control scheme provided in satisfaction of this clause 3.2.13 must be supplied to JEN with the Connection Application, together with sufficient evidence by way of power system studies that the proposed scheme allows the Performance Standard to be met. The functional description shall specify the conditions of operation of each reactive power control element (including generating units, switched capacitors or reactors, or other auxiliary reactive plant) under system normal operation and in response to power system disturbances.

2.2.14 ACTIVE POWER CONTROL

Automatic access standard

The generating system must have an active power control system that controls the rate of change of active power to below 50kW/second.

Minimum access standard

The generating system must have an active power control system that controls the rate of change of active power, subject to energy source availability, to below a value negotiated with JEN.

2.2.15 REMOTE MONITORING

Automatic access standard

The generating system must have remote monitoring equipment:

1. to transmit to JEN's control centre in real time the following quantities:

a) the generating system's connected status, tap-changing transformer tap position and voltages;

b) either the number of identical generating units operating or the operating status of each non-identical generating unit;

c) active power and reactive power aggregated for groups of identical generating units;

d) active power and reactive power for the generating system within a measurement accuracy of ±2 per cent of nominal MVA rating;

e) current on each of the three phases (A) within a measurement accuracy of ±1 per cent of nominal current rating;

f) in respect of a wind farm type of generating system:

i) wind speed;

ii) wind direction;

iii) ambient temperature; and

g) in respect of a solar photovoltaic or solar thermal type of generating system:

i) solar irradiance;

ii) solar collector orientation;

iii) ambient temperature;

h) alarm when generating system's harmonic voltage distortion emission limits, negative sequence current injection limit or zero sequence current injection limit as defined in clause 2.2.2 are exceeded; and

i) any other quantity that AEMO or JEN reasonably requires to discharge its market and power system security functions as set out in Chapters 3 and 4 of the NER;

2. to store in real time for later transmission to JEN, sampled recordings of active power, reactive power and voltage:

a) at the connection point;

b) if the generating system comprises a single generating unit, at the terminals of the generating unit;

c) if the generating system comprises two or more generating units, at the terminals of at least two individual generating units;

d) for at least one second prior to, and at least 10 seconds after, the detection of a power system event causing the voltage to exceed the limits for continuous uninterrupted operation under clause 3.2.4;

e) with a sample period of 0.02 seconds or less; and

f) time-stamped according to a clock maintained in synchronism among all event recording equipment within the generating system;

3. to store in real time for later transmission to JEN, time stamped GPS synchronised protection relay event logging and waveform oscillograghy for protection faults; and

4. to store in real time for later transmission to JEN, time stamped GPS synchronized power quality measurement logs.

Minimum access standard

5. The generating system must have remote monitoring equipment to transmit to JEN's control centre in real time the following quantities:

   a) Generator and Mains Incomer circuit breaker status;

   b) active power and reactive power for the generating system within a measurement accuracy of within ±2%; and

   c) in respect of a wind farm type of generating system:

      i) number of units operating;

      ii) wind speed; and

      iii) wind direction; and

   d) in respect of a solar photovoltaic or solar thermal type of generating system:

      i) number of units operating;

      ii) solar irradiance; and

      iii) collector orientation, if solar tracking equipment is installed.

2.2.16 COMMUNICATIONS EQUIPMENT

Automatic access standard

The Generator must:

1. provide and maintain two separate telephone facilities using independent telecommunications service providers, for the purposes of operational communications between the Generator's responsible operator under clause 4.11.3(a) of the NER and AEMO's and JEN's control centre;

2. provide electricity supplies for remote monitoring equipment and remote control equipment installed in relation to its generating system capable of keeping such equipment available for at least 3 hours following total loss of supply at the connection point for the relevant generating unit; and

3. disconnect from the distribution system immediately following failure of any non-redundant communications link that is required for protection purposes, or no more than 24 hours following failure of any redundant communications link that is required for protection purposes provided a duplicate communications link remains in service.

Minimum access standard

The Generator must:

4. provide and maintain a telephone facility for the purposes of operational communications between the Generator's responsible operator under clause 4.11.3(a) of the NER and AEMO's and JEN's control centre;

5. provide electricity supplies for remote monitoring equipment and remote control equipment installed in relation to its generating system capable of keeping such equipment available for at least 1 hour following total loss of supply at the connection point for the relevant generating unit; and

6. disconnect from the distribution system immediately following failure of any non-redundant communications link that is required for protection purposes, or no more than 24 hours following failure of any redundant

communications link that is required for protection purposes provided a duplicate communications link remains in service.

2.2.17 FAULT CURRENT

Automatic access standard

1. The contribution of the generating system to the fault current on the connecting network through its connection point must not exceed the contribution level that will ensure that the total fault current within the connecting network does not exceed the limits as set in Table 2–4;

Table 2–4: Maximum fault levels established under distribution and transmission codes

Voltage Level	System Fault Level	Short Circuit Level
220kV (TNSP)	15,000MVA	40.0kA
66kV (TNSP&DNSP)	2,500MVA	21.9kA
22kV	500MVA	13.1kA
11kV	350MVA	18.4kA
230V, 400V, 460V	36MVA	50kA
Residential 400V	7MVA	10kA (phase to phase)
Residential 230V, 460V	1.4MVA	6kA (phase to ground)

2. a generating system's connected plant must be capable of withstanding fault current through the connection point up to the higher of:

   a) the highest expected single phase and three phase fault levels at the connection point with the generating system not connected; and

   b) the highest level of current at the connection point that can be safely interrupted by the circuit breakers of the connecting network and safely carried by the connecting network for the duration of the applicable breaker fail protection system fault clearance times, as specified by JEN; and

3. a circuit breaker provided to isolate a generating unit or generating system from the network must be capable of breaking, without damage or restrike, the maximum fault currents that could reasonably be expected to flow through the circuit breaker for any fault in the network or in the generating unit or generating system, as specified in the connection agreement.

Minimum Access Standard

4. The contribution of the generating system to the fault current on the connecting network through its connection point must not exceed the contribution level that will ensure that the total fault current within the connecting network does not exceed the limits as set in Table 2–5;

Table 2–5: Maximum fault levels established under distribution and transmission codes

Voltage Level	System Fault Level	Short Circuit Level
220kV (TNSP)	15,000MVA	40.0kA
66kV (TNSP&DNSP)	2,500MVA	21.9kA
22kV	500MVA	13.1kA
11kV	350MVA	18.4kA
230V, 400V, 460V	36MVA	50kA
Residential 400V	7MVA	10kA (phase to phase)

Residential 230V, 460V	1.4MVA	6kA (phase to ground)

5. a generating system's connected plant must be capable of withstanding fault current through the connection point up to the highest expected single phase and three phase fault levels at the connection point with the generating system not connected; and

6. a circuit breaker provided to isolate a generating unit or generating system from the network must be capable of breaking, without damage or restrike, the maximum fault currents that could reasonably be expected to flow through the circuit breaker for any fault in the network or in the generating unit or generating system, as specified in the connection agreement.