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Overview of Revised AS/NZS4777

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What's this all about?

The objective of this session is to provide participants with an overview of the recent development with AS/NZS4777 and in particular the upcoming new features in inverters

- **AS/NZS 4777.1: 2016** - Grid connection of energy systems via inverters - Installation requirements
- **AS/NZS 4777.2:2015** - Grid connection of energy systems via inverters Part 2: Inverter requirements

AS/NZS 4777.1: 2016- GRID CONNECTION OF ENERGY SYSTEMS VIA INVERTERS - INSTALLATION REQUIREMENTS



- AS/NZS 4777.1 specifies the electrical and general safety installation requirements for inverter energy system (IES) up to or equal to 200kVA for the injection of electrical power to an electrical installation connected to the grid at low voltage.
- This standard should be used in adherence with the connection and technical requirements of the appropriate electricity distributor or local electricity legislations.

General Requirements

Clause 2.1 states that the installation should comply with the following :

- The inverter shall comply with the requirements of AS/NZS 4777.2.
- Where a PV array is used as an energy source, the installation of the array shall comply with AS/NZS 5033.
- Where lead acid batteries and/or nickel cadmium batteries are installed for energy storage, their installation shall comply with -
 - AS 4086.2-1997 (Secondary batteries for use with stand-alone power systems, Installation and maintenance) or the,
 - AS 3011 series - Electrical installations - Secondary batteries installed in buildings Part 1: Vented cells
- Where other energy storage technologies and sources are used, the installation shall be in accordance with manufacturer's instructions.



Clause 2.3 states that an IES installation comprises of an inverter, an energy source, wiring and control, monitoring and protection devices connected at a single point in an electrical installation

- The rating limit for a single-phase IES in an individual installation shall be equal to 5 kVA.
- A multi-phase IES shall have a balanced output with respect to its rating with a tolerance of no greater than 5 kVA unbalance between any phases.
- Installations in domestic dwellings shall not have maximum d.c. voltages that span greater than 600 V.
- For non-domestic installations where the maximum d.c. voltages exceed 600 V, the entire d.c. installation and associated wiring and protection shall have restricted access.
- The inverter shall comply with the requirements of AS/NZS 4777.2 to ensure safe operation.

Clause 3.2.3 states that in case of connection to the IES is by a flexible cable and connector or coupling device,

- The cable shall be secured to prevent inadvertent disconnection or mechanical stresses on electrical connections.
- No greater than 300 mm of flexible cable shall be unsupported.
- The flexible cable shall be provided with strain relief by a cable gland or clamping mechanism at each end of the flexible cable.



General Requirements for Wiring System

Clause 3.3.1 states that,

- All cables shall be installed and sized in accordance with AS/NZS 3000 and AS/NZS 3008.1.1.
- All the cables between the IES and any switchboard and all the cables between any distribution switchboards and the main switchboard that carry current from the IES shall have a current-carrying capacity of at least the rated current of the IES.



Installation Method for Wiring System

Clause 3.2.2 states that,

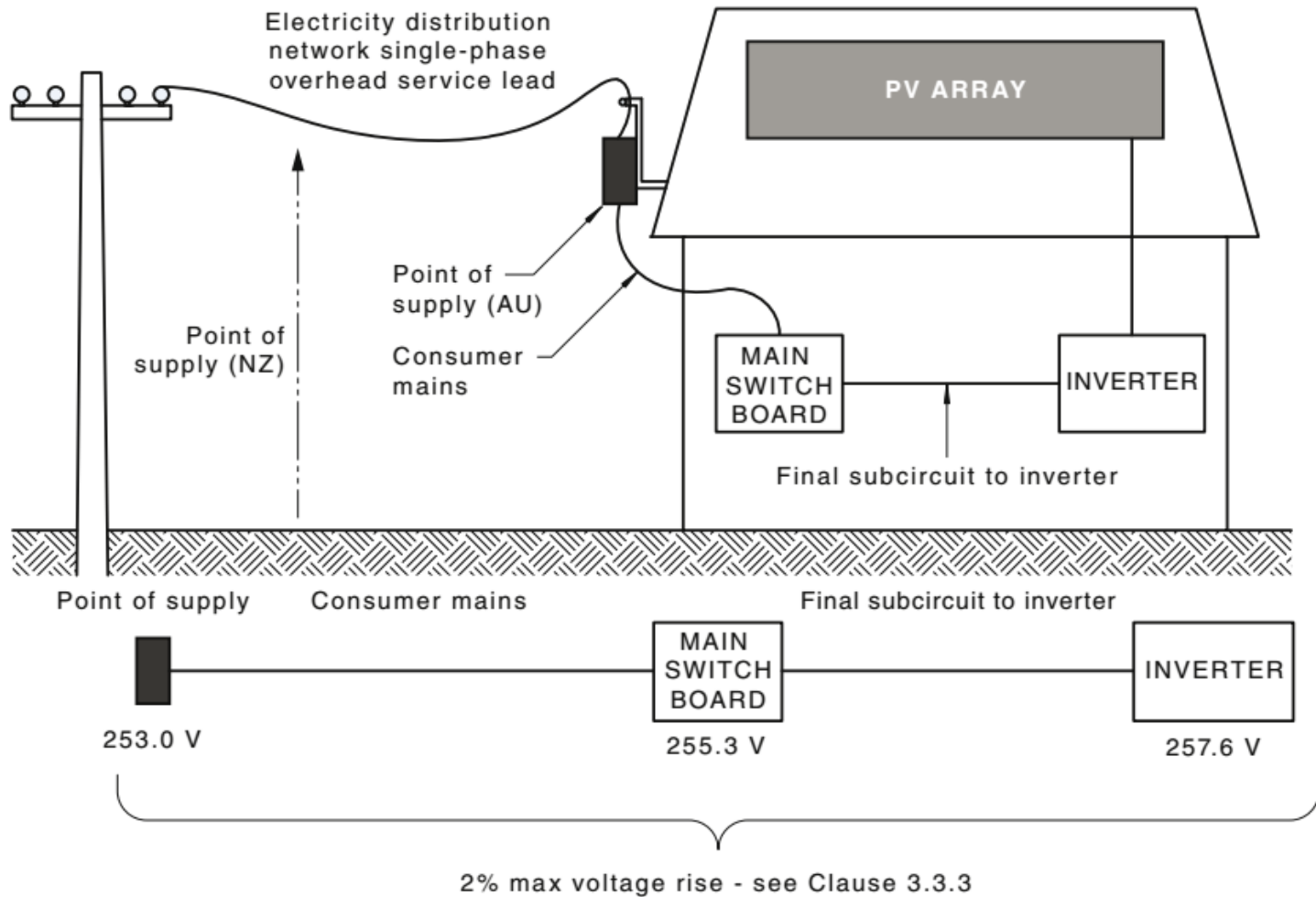
- All the cables should be installed in accordance with AS/NZS 3000.
- Cables shall not lie on roofs or floors without an enclosure or conduit.
- Cable enclosures and conduits on roofs or floors shall not obstruct the natural water drain paths or promote accumulation of debris.
- Cables shall be protected from abrasion, tension, compression and cutting forces that may arise from thermal cycles, wind and other forces during installation and throughout the service life of the IES.



Clause 3.3.3 states that,

- Under normal service conditions, the voltage at the terminals of any power consuming electrical equipment shall not be greater than the higher limit specified in the relevant electrical equipment Standard.
- The overall voltage rise from the point of supply to the inverter a.c. terminals (grid-interactive port) shall not exceed 2% of the nominal voltage at the point of supply.
- The value of the current used for the calculation of voltage rise shall be the rated current of the IES.

Voltage Rise



Clause 3.4.3 states that, an isolation switch or circuit-breaker shall:

- be provided on the switchboard to which the IES is directly connected
- be able to be secured in the open position
- operate in all active conductors
- be capable of breaking the rated current of the IES
- isolate the IES from that switchboard
- be installed in accordance with the requirements for main switches as per AS/NZS 3000 include the prohibition on the use of solid state devices for isolation
- be clearly labelled

Central and inverter integrated protection

As per clause 3.4.4, Central protection shall be installed to perform the following functions—

- (a) coordinate multiple IES installations at the one site;
- (b) provide protection for the entire IES installation;
- (c) provide islanding protection to the connected grid; and
- (d) preserve safety of grid personnel and the general public.

Any central protection shall be placed as close to the main switch (grid supply) of the installation as practicable. This protection is in addition to and separate from the inverter protection.

From table 1 of the AS/NZS4777.1 : 2016, additional central protection is required for the following –

- $15\text{kVA} < \text{IES} \leq 30\text{kVA}$: Phase balance protection where not integrated in the inverter
- $30\text{kVA} < \text{IES} \leq 200\text{kVA}$: Phase balance protection where not integrated in the inverter and Under/over voltage /frequency protection.

Phase Balance Protection

Clause 3.4.4.2 states that,

- Phase Balance Protection shall respond to current imbalance at the IES connection point caused by an IES (or multiple IES) between phases greater than 21.7A (5 kVA at 230 V) by disconnecting all IES from the installation by automatic operation of a disconnection device located adjacent to the main switch (Inverter supply) or adjacent to the inverters and/or the internal inverter disconnection device by asserting DRM 0 to the inverter.
- The disconnection device shall operate when there is loss of power to the central protection, loss of control signal from the central protection or an internal fault in the central protection.
- Phase balance protection shall operate within 30 seconds.

Central Voltage and Frequency Protection Requirements

Setting Parameter	Disconnection time	In Australia only	In New Zealand only
Sustained over voltage (V>)*	15 seconds	255 V	246 V
Over voltage (V>)	2 seconds	260 V	250 V
Under voltage (V<)	2 seconds	180 V	180 V
Over frequency (F>)	2 seconds	52 Hz	52 Hz
Under frequency (F<)	2 seconds	47 Hz	45 Hz

Table 2, AS/NZS 4777.1:2016

Residual Current Devices (RCDs)

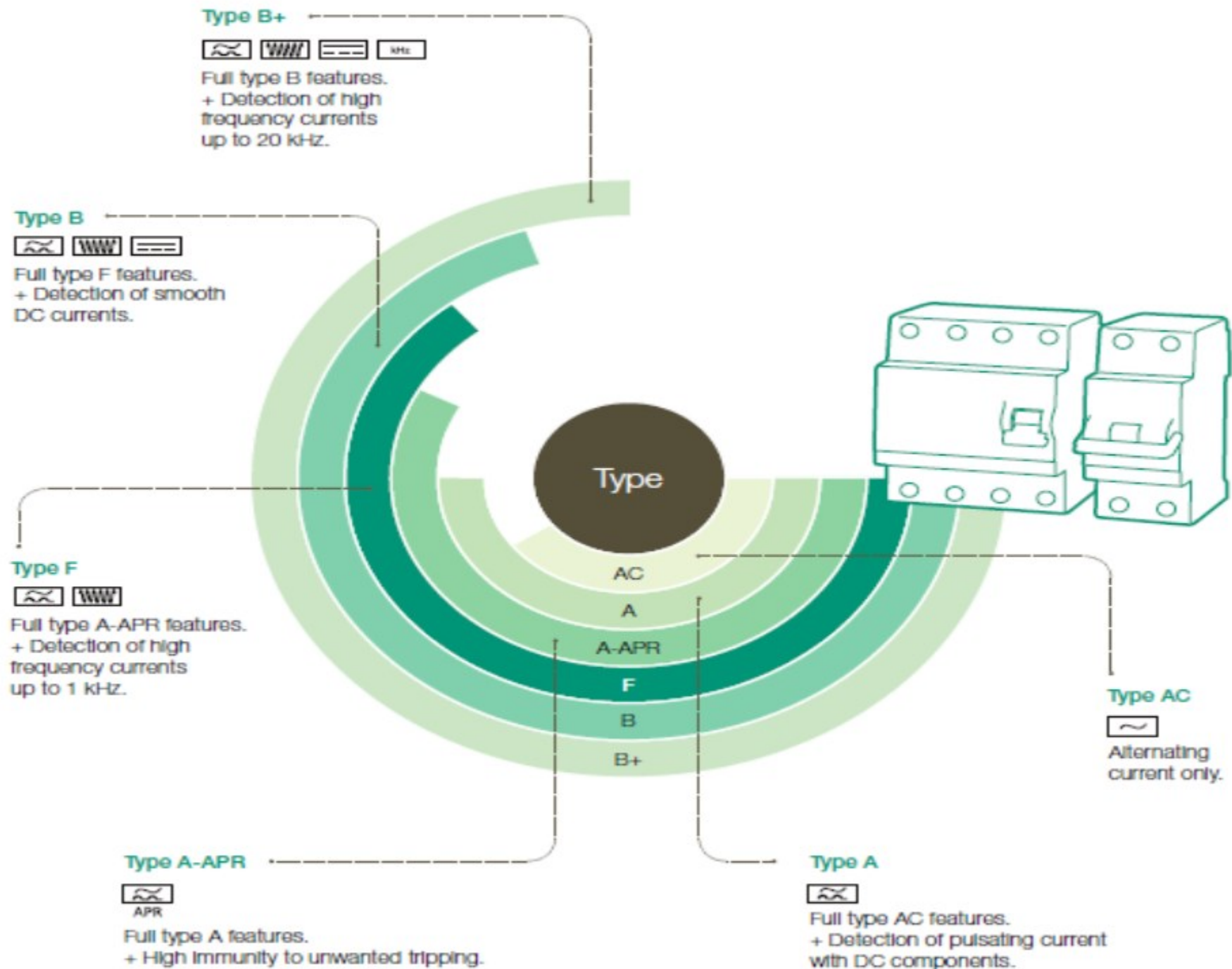
Clause 3.4.5 use of a dedicated RCD between the IES and the MSB, is now permitted as a means to meet mechanical cable protection requirements for grid-connect only inverters.

However, this configuration is not allowed on a multiple mode inverter with standalone functionality in use.

If the multiple mode inverter disconnects the stand-alone port neutral conductor from the main installation neutral when it switches to stand-alone mode, it will remove both the earth reference required for RCDs (whether RCCB or RCBO) to operate in earth leakage mode, which can then create shock hazards

The RCD shall:

- disconnect all live conductors (including the actives and neutral)
- be of the type specified in the inverter manufacturer's instructions or as labelled on the inverter.



Clause 3.4.8 states that, the export control for an IES is used to control the generation from an IES and amount of energy exported from an electrical installation to the grid. The export control function may be integrated into the inverter or an external device.

The export control function for an IES may operate with the following export limits:

- *Hard limit*: A limit that will require the IES to disconnect.
- *Soft limit*: A limit that will cause the IES to reduce its output, preventing ongoing export greater than the limit.

Clause 3.4.8.2 states that the hard limit of an export control function may apply to an IES that has a capacity greater than 30 kVA.

- Where the limit is in total kVA, or total kW for multi-phase systems, this shall be the net amount at the point of supply across all phases.
- For both single and three-phase systems, the export function shall monitor the export on each phase.

- When export control function is an external device:
 - Where the net export limit is exceeded, the export control function shall ensure the IES has completed operating the disconnection device within two seconds.
 - If the IES loses its connection with the export control device, the IES shall operate its disconnection device.
- When export control function is integrated into inverter:
 - Where the net export limit is exceeded, the export control function shall be used to disconnect the IES and cease exporting within two seconds.
 - If the IES loses its connection with external devices required for the export control function, the IES shall operate its disconnection device.

Clause 3.4.8.3 states that the soft limit of an export control function may apply to all types of IES.

- Where the limit is in total kVA, or total kW for multi-phase systems, this shall be the net amount at the point of supply across all phases.
- Where the net export limit is exceeded, the export control function shall operate to ensure the IES meets the export conditions within 15 seconds.
- If the IES and/or export control function loses its connection with the external device, the IES shall reduce IES output, to the limit setting as a maximum. The connection shall be re-established and stable for a minimum of 60 seconds before the export control function is restored.

Examples



Overcurrent Protection

- Where the energy source is a PV array, AS/NZS 5033 shall be used to determine if overcurrent protection is required and at which locations.
- All other energy source cabling shall be protected against overcurrent in accordance with AS/NZS 3000.
- Where the energy system incorporates a battery storage system, overcurrent protection shall be provided to protect, as far as practicable, all wiring from prospective short circuit current or overload current from the battery storage system.
- The wiring from the battery terminals to the overload protection device should be as short as possible.

- A labelled isolation device, able to be secured in the open position, shall be provided between any energy source and the inverter.
- This device shall comply with the requirements of devices for isolation and switching in AS/NZS 3000 and be capable of safely breaking voltage and current under both normal and fault conditions.
- The isolation device shall be located adjacent to the inverter energy source port and be readily available unless the energy storage and the inverter are physically integral, in which case the requirements of AS 62040.1.1 shall be adhered to.
- Where there are multiple inverter energy source ports, each port shall have an isolator for each connected energy source.

Segregation of Circuits

Clause 5.2 states that,

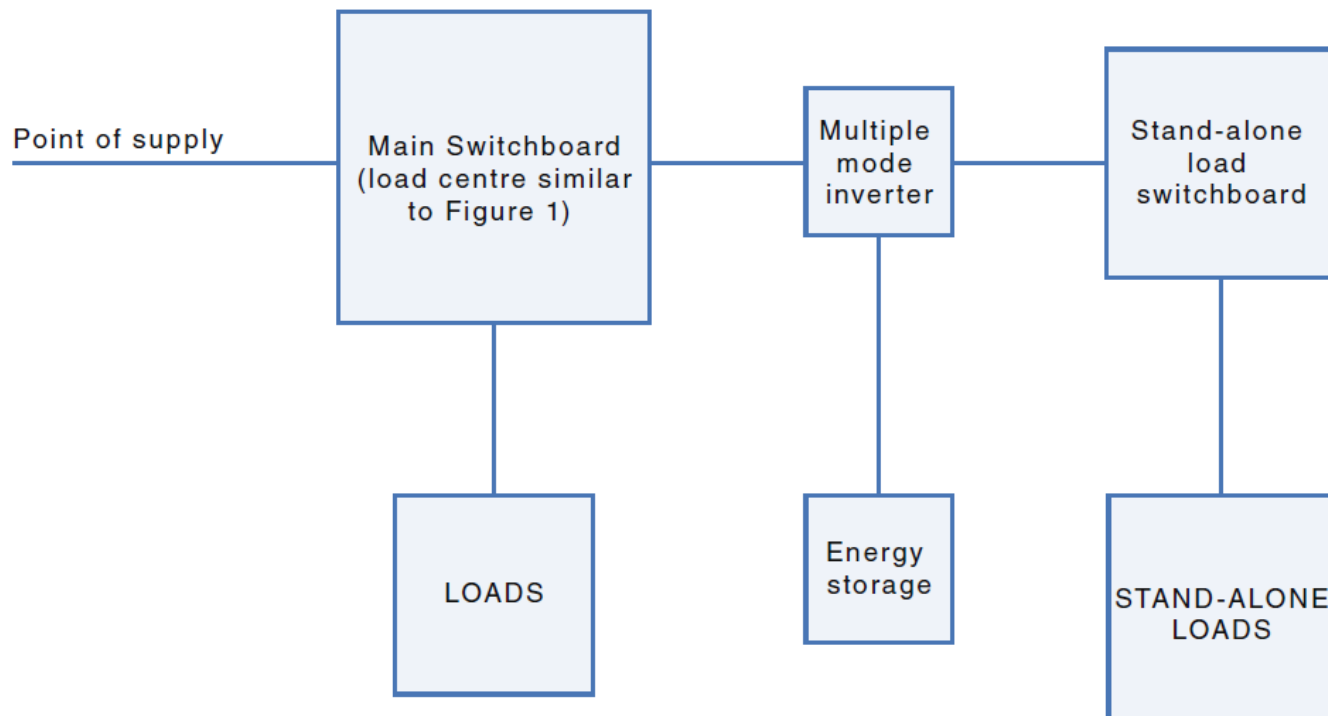
- In addition to the requirements in AS/NZS 3000, segregation shall be provided between d.c. and a.c. circuits within enclosures such that connections and pathways are physically segregated from each other by an insulating barrier.
- Where devices such as switches for circuits requiring segregation are mounted on a common mounting rail in an enclosure, this rail shall not be metallic or conductive
- Segregation insulation barriers between the d.c. and a.c. circuits shall be equivalent to double insulation for the highest voltage level present and appropriate for the installation environment.
- Outside of enclosures, a separation of 50 mm or a segregation insulation barrier between a.c. and d.c. circuits shall be provided.
- Segregation insulation barriers between the d.c. and a.c. circuits shall be to the appropriate level for the installation environment and not less than IP4X.

Segregation of Circuits



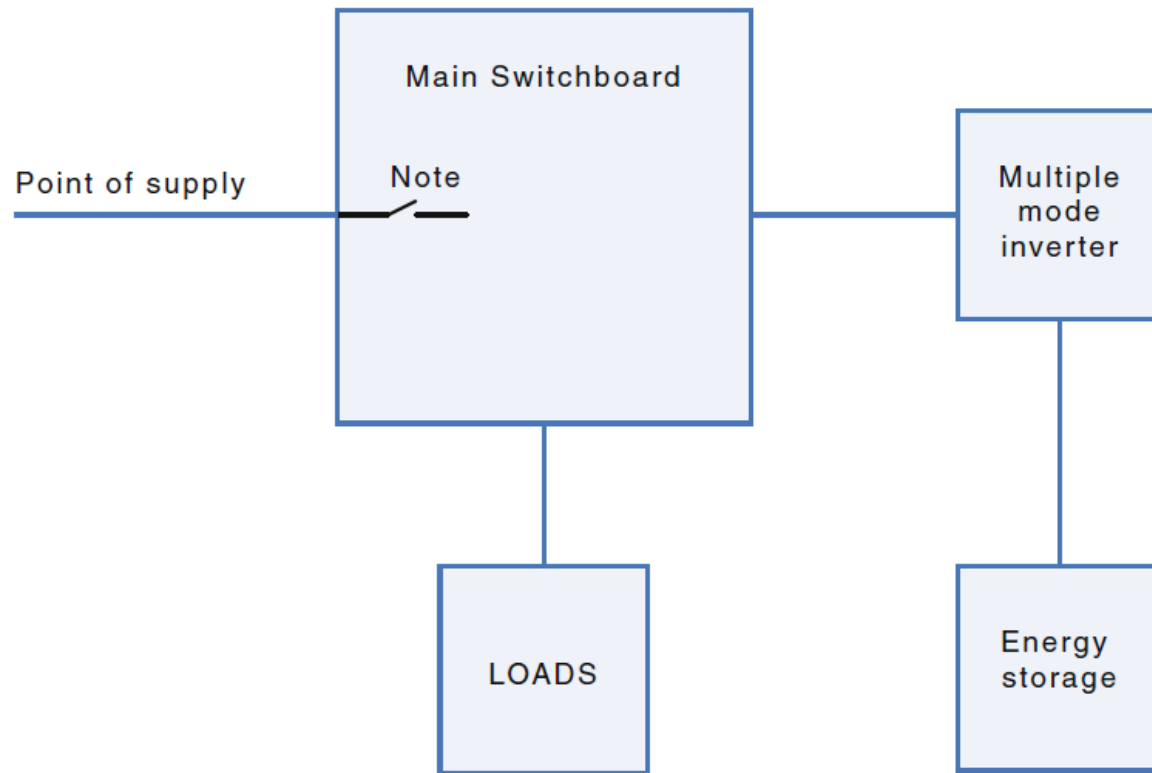
Multiple Mode IES

The inverter shall comply with the requirements of AS/NZS 4777.2 for multiple mode inverters with a stand-alone functionality.



Typical Multiple mode IES with separate stand alone loads (Figure 3, AS/NZS 4777.1:2016)

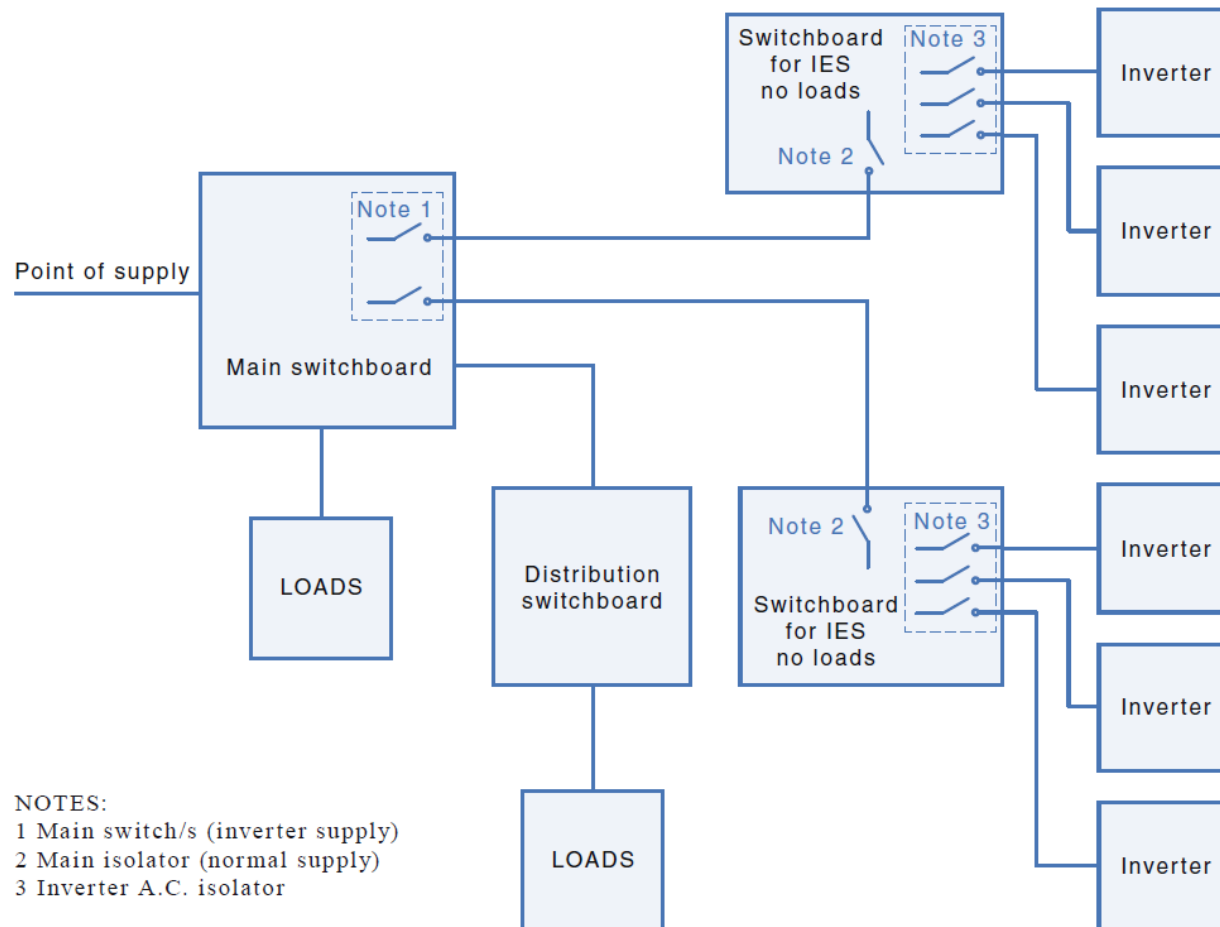
Multiple Mode IES



Typical Multiple mode IES with external disconnection device to separate from grid and provides stand alone supply

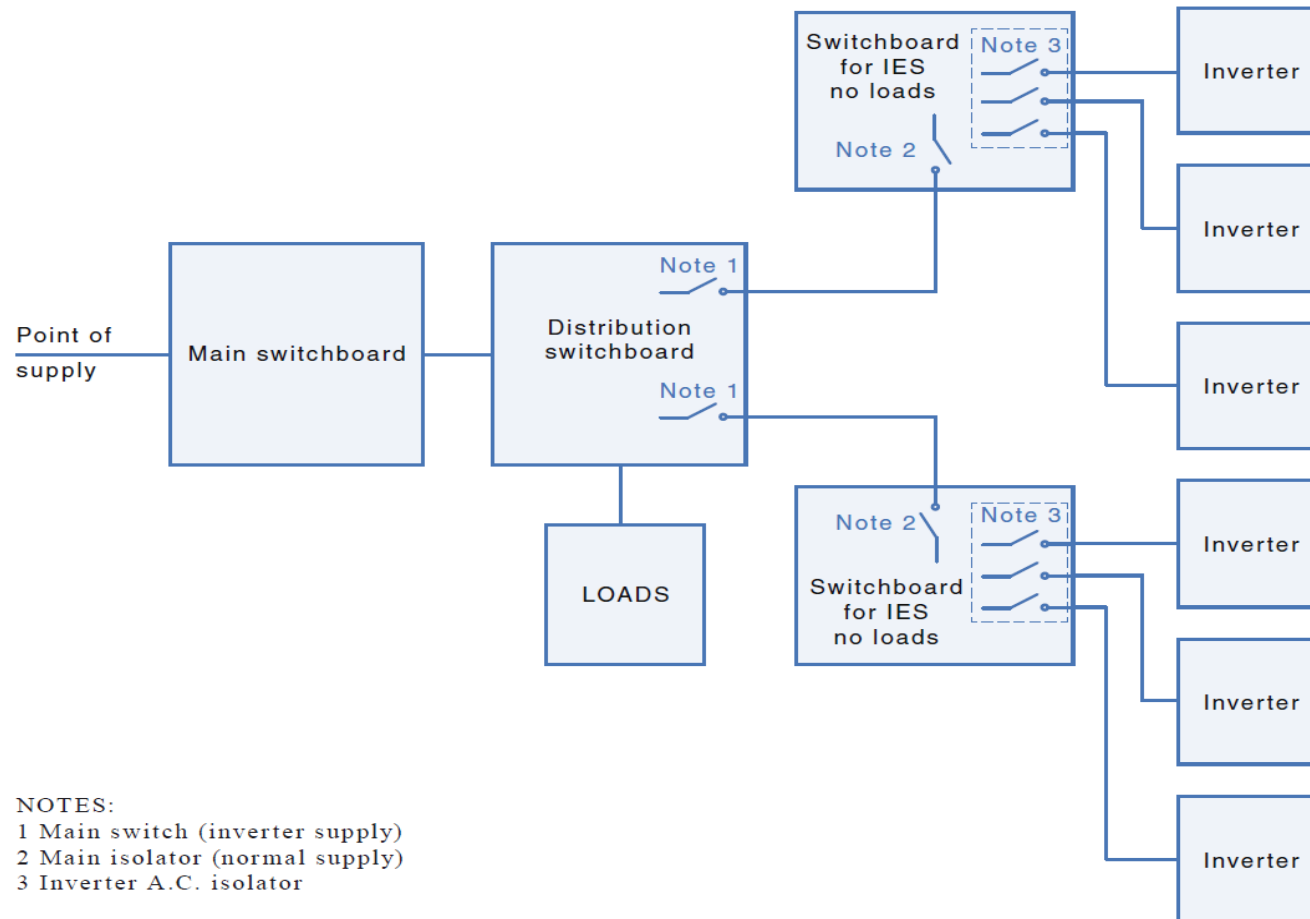
Note: An external disconnection device is controlled by the multiple mode inverter that switches from grid-connect mode to stand-alone mode. (Table 4, AS/NZS 4777.1:2016)

Multiple Inverter Installation



Typical Multiple Distribution Boards used as aggregation points for the IES then connected to a main Switchboard. (Figure 5, AS/NZS 4777.1:2016)

Multiple Inverter Installation



Typical Multiple Distribution boards used as aggregation points for the IES then connected to a distribution switchboard (Figure 6, AS/NZS 4777.1:2016)

Signage



WARNING
MULTIPLE SUPPLIES
ISOLATE ALL SUPPLIES
BEFORE WORKING ON THIS
SWITCHBOARD

Typical sign for the switchboard to which the IES is connected



WARNING
MULTIPLE SUPPLIES
ISOLATE INVERTER SUPPLY
AT DISTRIBUTION BOARD
IN PLANT ROOM

Typical sign for a main switchboard or intermediate distribution switchboards when the IES is connected to a subsequent distribution switchboard

ENERGY SOURCE

SHORT CIRCUIT CURRENT _____ A
MAX DC VOLTS _____ V

Typical labelling of energy source located at isolation point

BATTERY SUPPLY
SHORT CIRCUIT CURRENT 6000A
MAX DC VOLTS 160V

Example battery energy source label
Located on battery enclosure

Signage



WARNING
FOLLOW IES SHUTDOWN
PROCEDURE PRIOR TO
OPERATING THIS ISOLATOR

Example label where specific operational Considerations for isolation exist



Example of energy storage label required at main switchboard for emergency workers

DRM 0	☐	DRM 1	☐	DRM 2	☐
DRM 3	☐	DRM 4	☐	DRM 5	☐
DRM 6	☐	DRM 7	☐	DRM 8	☐

Example of demand response labelling on inverter showing DRM functions available



WARNING
MULTIPLE MODE IES CONNECTED
NEUTRAL AND EARTH CIRCUITS MAY
BE LIVE UNDER FAULT CONDITIONS
FOLLOW SHUTDOWN PROCEDURE

Typical warning sign for main switchboard and Intermediate distribution boards

AS/NZS 4777.2: 2015- GRID CONNECTION OF ENERGY SYSTEMS VIA INVERTERS - INVERTER REQUIREMENTS



- This Standard specifies requirements and tests for low voltage inverters for the injection of electric power through an electrical installation into the grid at low voltage. This Standard applies to inverters that have power flow in either direction between the energy source and the grid.
- This Standard needs to be read in conjunction with the regulations, service and installation rules of the electricity distributor approving the connection. This Standard should also be read in conjunction with AS/NZS 3000.

Clause 5.3 states that,

- For inverter energy systems used with PV array systems that require earth fault detection and a residual current detection, either internal or external to the inverter, the type of detection used shall be declared in accordance with IEC 62109-1 and IEC 62109-2.
- Where the additional detection for functionally earthed PV arrays, as required by AS/NZS 5033, is present in the inverter, this additional detection shall, before start-up of the system:
 - open circuit the functional earth connection to the PV array;
 - measure the resistance to earth of each conductor of the PV array;
 - if the earth resistance is above the resistance limit (Riso limit) threshold, the system shall reconnect the functional earth and shall be allowed to start;
 - if the earth resistance is equal to or less than the resistance limit (Riso limit) threshold, the inverter shall shut down and initiate an earth fault alarm in accordance with the requirements of IEC 62109-2.

Clause 5.5 states that,

- The displacement power factor of the inverter, considered as a load from the perspective of the grid, shall, for all current outputs from 25% to 100% of rated current, operate at unity power factor within the range 0.95 leading to 0.95 lagging.
- Operation at power factor other than unity is acceptable where the inverter operates in power quality response modes.

Harmonic Currents

Clause 5.6 states that ,the harmonic currents of the inverter shall not exceed the limits specified in the tables below. The total harmonic current distortion to the 50th harmonic shall be less than 5%.

Odd harmonic order number	Limit for each individual odd harmonic based on percentage of fundamental
3,5 and 7	4%
9,11 and 13	2%
15,17 and 19	1%
21,23,25,27,29,31 and 33	0.6%

Even harmonic order number	Limit for each individual even harmonic based on percentage of fundamental
2,4,6 and 8	1%
10,12,14,16,18,20, 22,24,26,28,30 and 32	0.5%

Clause 5.9 states that

- In the case of a single-phase inverter, the d.c. output current of the inverter at any a.c. port including the grid-interactive and/or stand-alone port shall not exceed 0.5% of the inverter's rated current or 5 mA, whichever is the greater.
- In the case of a three-phase inverter, the d.c. output current of the inverter at any a.c. port, including the grid-interactive and/or stand-alone port, measured in each of the phases, shall not exceed 0.5% of the inverter's per-phase rated current or 5 mA, whichever is the greater.
- For any inverter capable of injecting d.c. fault current into the electrical installation the selection of an RCD, where required, needs to be such that the RCD operates correctly with the level of d.c. fault current being injected.

Current Balance for Three Phase Inverter

Clause 5.10 states that

- In the case of a three-phase inverter the a.c. output current shall be generated and injected into the three-phase electrical installation as a three-phase balanced current.
- The a.c. output current for each phase for three-phase balanced current shall be within 5% of the measured value of the other phases at rated current when injected into a balanced three phase voltage.

Inverter Demand Response Modes (DRMs)

Mode	Requirement
DRM 0	Operate the disconnection device
DRM 1	Do not consume power
DRM 2	Do not consume at more than 50% of rated power
DRM 3	Do not consume at more than 75% of rated power and source reactive power if capable
DRM 4	Increase power consumption (subject to constraints from other active DRMs)
DRM 5	Do not generate power
DRM 6	Do not generate at more than 50% of rated power
DRM 7	Do not generate at more than 75% of rated power and sink reactive power if capable.
DRM 8	Increase power generation (subject to constraints from other active DRMs)

NOTE: Demand response modes of Table 5 are as described in AS/NZS 4755.3 series of Standards

Demand Response Management is defined as being the automated alteration of an electrical product's normal mode of operation in response to an initiating signal originating from or defined by a remote agent. (Table 5, AS/NZS 4777.2:2015)



Clause 6.2.2 states that,

- A Demand Response Enabling Device (DRED) acts to provide the interface between the remote agent (i.e. the grid) and the demand controller built into the inverter.
- DREDs must be connected to the DRM port of the inverter as per the manufacturer's guidelines. In some of the cases where a DRM port is not available, DREDs should be installed according to manufacturer's specifications. The communication cabling for such devices shall be protected and isolated from other cables.

Inverter Power Quality Response Modes

Clause 6.3.1 states that, Inverters may be capable of providing support to the grid by working outside the typical operating characteristics of an inverter. There various operating modes may be enabled or disabled in the inverter and may include following:

- Volt response modes
- Fixed power factor or reactive power mode
- Power response mode
- Power rate limit

Volt Response Mode

Clause 6.3.2 states that the mode responds to voltage changes at the inverter terminals and helps to increase the number of systems that can be connected at a point on the grid without affecting the voltage within an electrical installation. Each of the voltage response modes may be programmed for different response values from the other modes, thus allowing for different response curves in different modes to suit local distributor requirements.

Reference	Australian Default Value (V)	Range (V)
V1	207	NA
V2	220	216 to 230
V3	250	235 to 255
V4	265	244 to 265

Volt Response Reference Values (Table 9, AS/NZS 4777.2:2015)

Volt Watt Response Mode

Clause 6.3.2.2 states that in this mode, the output power of the inverter is varied in response to terminal voltage. If this mode is available, it shall be enabled by default. The table below shows the maximum set point values for reference voltages.

Reference	Maximum Value (P/P_{rated}), %
V1	100%
V2	100%
V3	100%
V4	20%

Table 10, AS/NZS 4777.2:2015

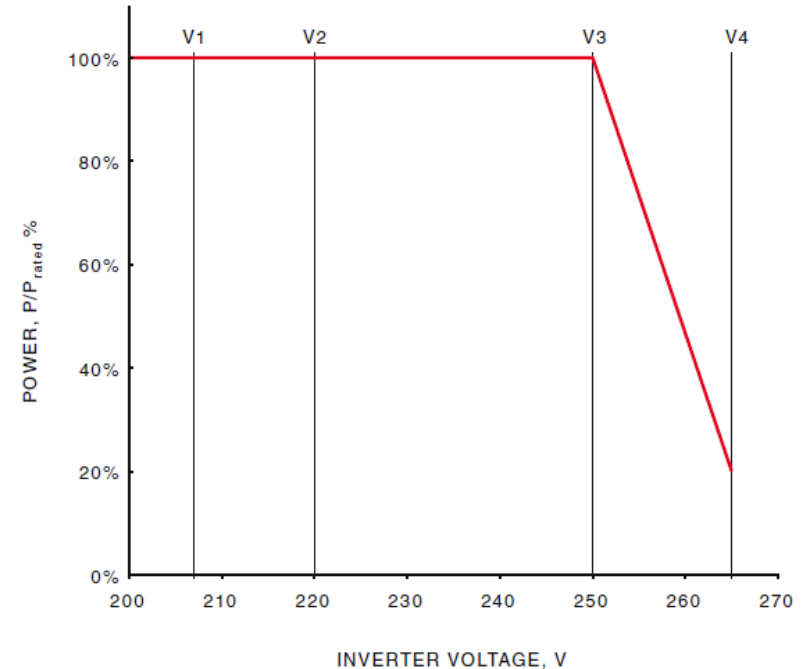


Figure 2(A), AS/NZS 4777.2:2015

Volt Var Response Mode

Clause 6.3.2.3 states that, In this mode, the reactive power output of the inverter is varied in response to the voltage at its grid interactive port. Some inverters include an optional Volt VAr response capability which is disabled by default.

Reference	Default values for VAr level (VAr % rated VA)	Minimum Range
V1	30% leading	0 to 60% leading
V2	0%	0%
V3	0%	0%
V4	30% lagging	0 to 60 % lagging

Table 11, AS/NZS 4777.2:2015

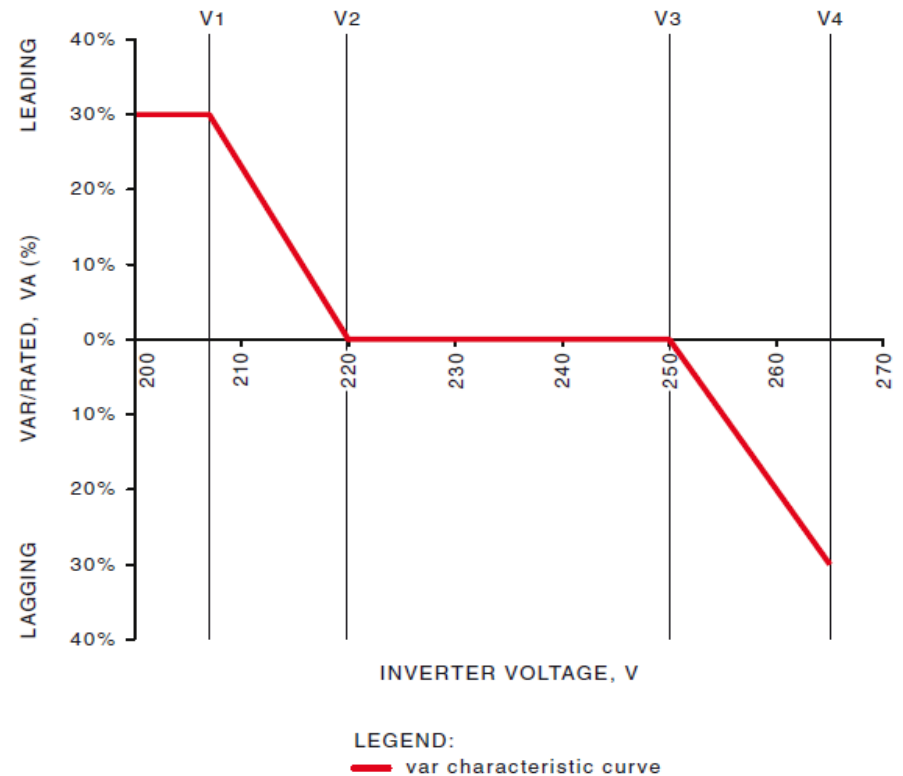


FIGURE 3 EXAMPLE CURVE FOR A POSSIBLE VOLT-VAR CONTROL MODE (AUSTRALIA)

Figure 3, AS/NZS 4777.2:2015

Voltage Balance Mode

Clause 6.3.2.4 states that,

- Voltage balancing mode is where a three-phase inverter or single-phase inverters used in a three-phase combination are used to balance the voltages between phases on a customer's installation by injecting unbalanced three-phase currents into the installation.
- For example if "A" phase is more heavily loaded than "B" and "C" phases, the voltage on "A" phase would normally drop in comparison to "B" and "C" phases. By injecting more current into the "A" phase than into the "B" and "C" phases the heavier load is offset and the installation voltage is balanced.
- The voltage balance mode must be able to detect faults and either:
 - operate correctly with a single fault applied
 - disconnect the inverter from the electrical installation
 - for three phase inverters, force the inverter to revert to injecting current into the three phase electrical installation as a three phase balanced current.

Clause 6.3.5 states that,

- The power rate limit for an inverter is a power quality response mode which states that inverter shall have the capability to rate limit changes in power generation through grid interactive mode.
- The power rate limit does not apply when the inverter disconnection device is required to operate.
- The power rate limit causes the inverter power output to either ramp up or ramp down smoothly as it transitions from one power output level to another power output level.
- These changes in power output level are constrained by several factors such as the type of energy source connected, energy storage and operating state of the inverter.
- Ramp rates are adjustable between 5% and 100% of rated power per minute and may be different for ramp up to that for ramp down.

Clause 6.3.3 states that,

- The fixed power factor mode and the reactive power mode may be required in some situations by the electrical distributor to meet local grid requirements and should be disabled by default.
- If the inverter is capable of operating with reactive power mode, the maximum ratio of reactive power (VARs) to rated apparent power should be 100%.
- If the inverter is capable of operating with fixed power factor mode, the minimum range of settings should be 0.8 leading to 0.8 lagging.

Multiple Mode Inverter Operation

Clause 6.4.1 states that,

- When the multiple mode inverter is disconnected from the grid any stand-alone port shall ensure that all active conductors are also isolated from the grid-interactive port.
- Multiple mode inverters shall be arranged to ensure that the continuity of the neutral conductor to the load from the electrical installation is not interrupted when the inverter disconnects from the grid and supplies a load via the stand-alone port.
- Multiple mode inverters shall be arranged such that only the allowed installation methods of AS/NZS 3000 and AS/NZS 4777.1 can be used.
- The a.c. output voltage waveform of a stand-alone mode shall have a voltage total harmonic distortion (THD) not exceeding of 5% and no individual harmonic at a level exceeding 5%.

Active Anti-Islanding Protection

Clause 7.3 states that, the automatic disconnection device shall incorporate at least one method of active anti-islanding protection such as :

- **Frequency Shift:** shifting the frequency of the inverter away from nominal conditions in the absence of a reference frequency
- **Frequency Instability:** allowing the frequency of the inverter to be inherently unstable in the absence of a reference frequency
- **Power Variation:** periodically varying the output power of the inverter
- **Current Injection:** monitoring for sudden changes in the impedance of the grid by periodically injecting a current pulse

Voltage and Frequency Limits

Clause 7.4 states that the automatic disconnection device shall incorporate the following forms of passive anti-islanding protection:

- Undervoltage and overvoltage protection.
- Under-frequency and over-frequency protection.

Protective Function	Protective Function Limit	Trip Delay Time	Maximum Disconnection Time
Undervoltage (V<)	180 V	1 s	2s
Overvoltage (V>)	260 V	1 s	2s
Overvoltage (V>>)	265 V	-	0.2 s
Under frequency (F<)	47 Hz (Aus) 45 HZ (NZ)	1 s	2 s
Over frequency (F>)	52 Hz	-	0.2 s

Passive Anti-islanding Set-point Values (Table 13, AS/NZS 4777.2:2015)

Response to Increase in Frequency

Clause 7.5.3.1 states that,

- The inverter shall be capable of supplying rated power between 47 Hz and 50.25 Hz for Australia.
- An inverter shall reduce the power output linearly with increase in the frequency of the grid.
- The Power level present at the time that frequency reaches or exceeds 50.25 Hz shall be used as reference power level used to calculate the required response to the increasing frequency.
- The object of this mode is to avoid forcing up the grid frequency by continuing to supply power into the grid during over-frequency events whilst still allowing the inverter to remain connected to the grid.

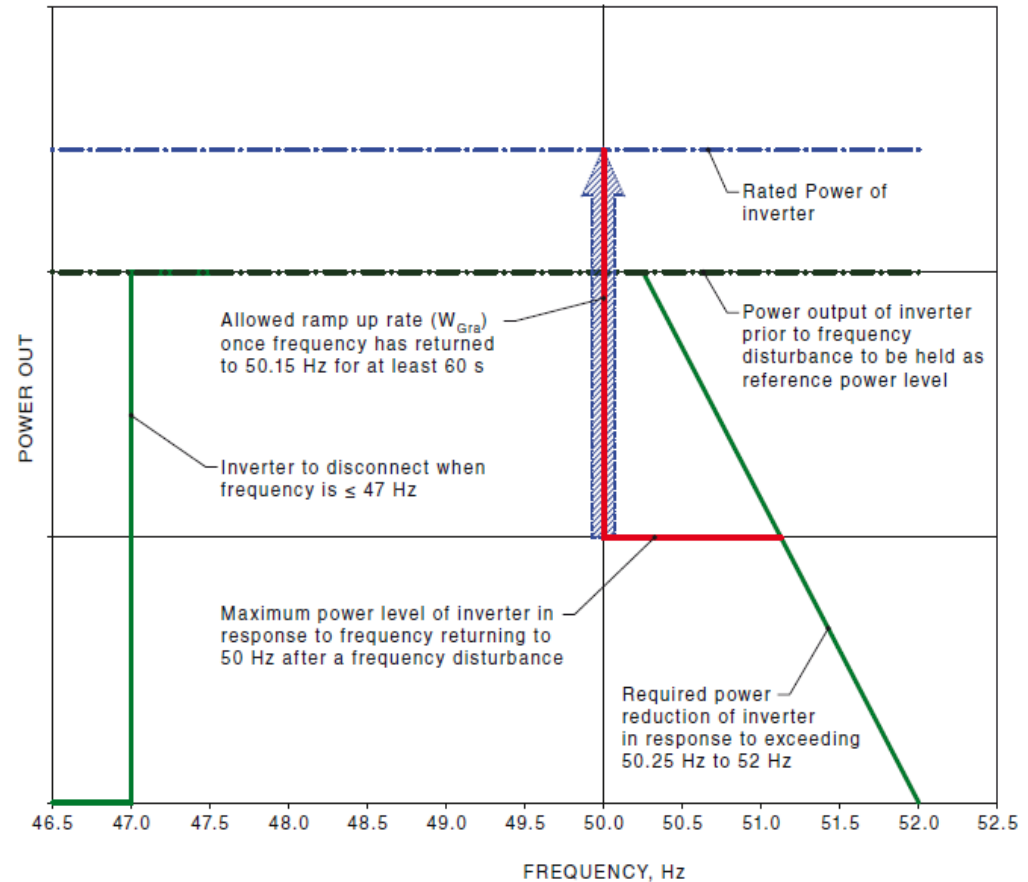


FIGURE 7(A) EXAMPLE FREQUENCY RESPONSE FOR OVER-FREQUENCY CONDITIONS FOR f_{stop} OF 52 Hz

Response to Grid Frequency

Clause 7.5.3.2 states that,

- This requirement is applicable only to the inverter with energy storage capabilities. The inverter shall be capable of charging the energy storage between 49.75 Hz and 52.0 Hz.
- An inverter with energy storage which is charging from the grid port should reduce the power input for charging linearly with a decrease of frequency until Frequency Stop Charging ($f_{\text{stop-CH}}$) is reached, where $f_{\text{stop-CH}}$ lies in the range 47–49 Hz.
- The Power level present at the time the frequency reaches or falls below 49.75 Hz shall be used as reference charge rate used to calculate the required response to the decreasing frequency.

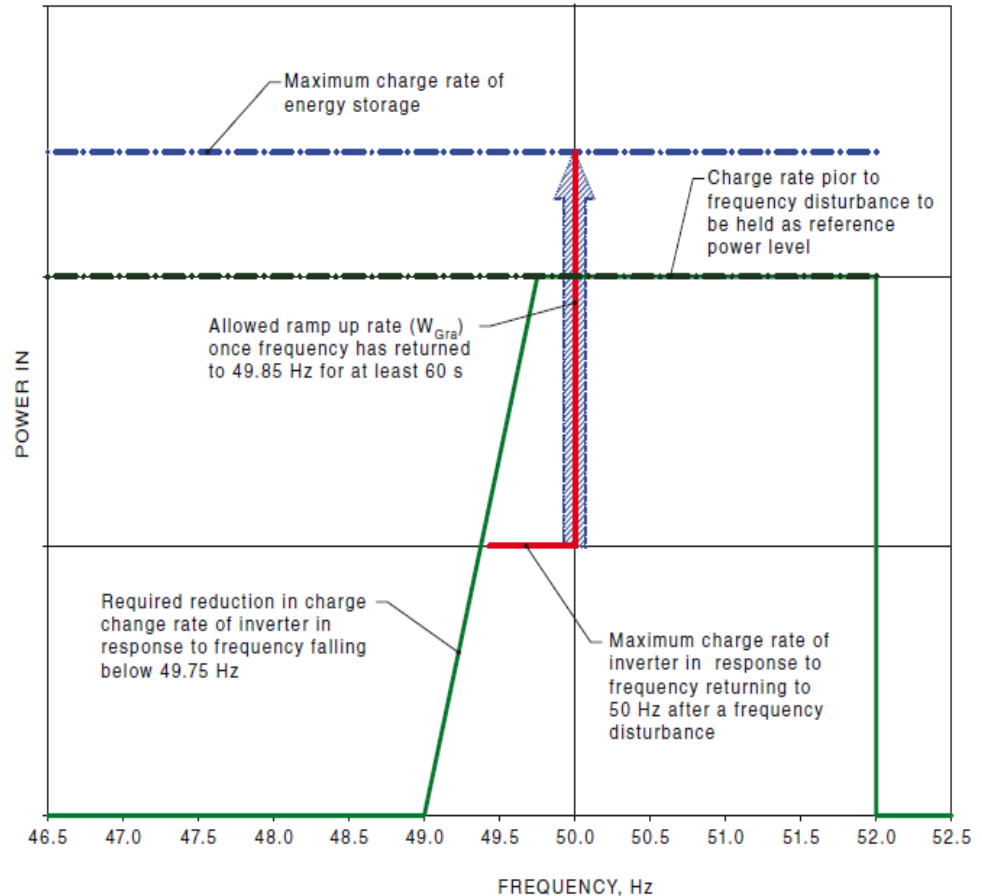


FIGURE 7(B) EXAMPLE FREQUENCY RESPONSE FOR UNDER-FREQUENCY CONDITIONS
FOR $f_{\text{stop-CH}}$ OF 49 HZ

Multiple Inverter Combinations

Clause 8.1 states that,

- Where multiple inverters are used in combination to provide the desired inverter capacity or to maintain voltage balance to the grid e.g. single phase inverters in parallel, single phase inverters in multiple phase combinations or three phase inverters in parallel, these combinations must be tested together by the manufacturer or an external protection device used.
- It should be noted that this could have significant cost implications for people wanting to upgrade existing installations by adding additional capacity in parallel with their existing inverters as external protection devices will most likely be required, particularly with older inverters.
- AS/NZS 4777.2:2015 Section 8 sets out the requirements for testing of multiple inverter combinations.

Residual Current Device (RCD)

Where an external RCD is required, the following or an equivalent statement shall be included in the documentation: 'External RCD Required'. The documentation shall also state the rating and type of RCD required and provide instructions for the installation of the RCD.

- Where an external RCD is required for an inverter, warning signs are required indicating the requirement for, type of and rating of the RCD required.
- The installer should ensure that appropriate DRM labelling is either already provided on the inverter by the manufacturer, or is applied to the inverter as required.
- This label shall indicate the demand response modes of which the unit is capable. It shall indicate on the label which functions have been connected and enabled.
- In Australia and New Zealand refer to AS/NZS 4777.2 Clause 9.2.5 for detailed information related to warning labels where external RCD's are required by an inverter.

DRM 0	☐	DRM 1	☐	DRM 2	☐
DRM 3	☐	DRM 4	☐	DRM 5	☐
DRM 6	☐	DRM 7	☐	DRM 8	☐