Inverter Energy System Embedded Generators Protection Requirements and Settings Summary

Purpose:

To assist the installers by providing a clear summary of the protection requirements and settings that are applicable to the:

- Micro Embedded Generator Basic Connection Service with Voltage Response Modes Enabled (from 1st December 2019), with inverter installation installed capacity of up to 10kVA per phase (or 30kVA per three phase) AND export limit of up to 5 kVA per phase (or 15 kVA three phase);
- Micro Embedded Generator Basic Connection Service (Voltage Response Modes Not Enabled – only applicable to 31st March 2020), with inverter installation installed capacity of up to 10kVA per phase (or 30kVA per three phase) AND export limit of up to 5 kVA per phase (or 15 kVA three phase)
- Embedded Generator Negotiated Connection Service (Voltage Response Modes Enabled), with inverter installation installed capacity greater than 30 kVA and up to 200 kVA (3 phase).

Micro Embedded Generator Basic Connection Service (Voltage Response Modes Enabled)

Applies To

- Inverter installation installed capacity is less than or equal to 10 kVA per phase (or 30 kVA per three phase).
- Export limit must not exceed 5 kVA per phase (or 15 kVA three phase).
- Installations from 1st December 2019 with voltage response mode functionality.

Central Protection Requirements

None

Inverter Protection Requirements

The inverter will have the following set points and disconnection times aligned with AS4777.2:2015:

Protective Function	Protective Function Limit	Trip delay Time	Maximum disconnection Time
Undervoltage (V<)	180 V	1 s	2 s
Overvoltage 1 (V>)	260 V	1 s	2 s
Overvoltage 2 (V>>)	265 V	-	0.2 s
Sustained Overvoltage (10 minutes)	258 V		3 s
Under-frequency (F<)	47 Hz	1 s	2 s
Over-frequency (F>)	52 Hz	-	0.2 s
Active anti-islanding (loss of mains)	-	-	2 s
Reconnection delay	60 s		

The inverter's **volt-watt** response values must be set at:

Reference	Voltage (V)	Active Power (P/Prated) %
V1	207 V	100%
V2	220 V	100%
V3	253 V	100%
V4	259 V	20%

The inverter's **volt-var** response values must be set at:

Reference	Voltage (V)	Reactive Power (VAr % rated VA)
V1	208 V	44% leading (export VAr)
V2	220 V	0%
V3	241 V	0%
V4	253 V	44% lagging (import VAr)

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.

Micro Embedded Generator Basic Connection Service (Voltage Response Modes Not Enabled)

Applies To

- Inverter installation installed capacity is less than or equal to 10 kVA per phase (or 30 kVA per three phase).
- Export limit must not exceed 5 kVA per phase (or 15 kVA three phase).
- Installations from 1st December 2019 without voltage response mode functionality. Grace period runs until 31st March 2020.

Central Protection Requirements

None

Inverter Protection Requirements

The inverter will have the following set points and disconnection times aligned with AS4777.2:2015:

Protective Function	Protective Function Limit	Trip delay Time	Maximum disconnection Time
Undervoltage (V<)	180 V	1 s	2 s
Overvoltage 1 (V>)	260 V	1 s	2 s
Overvoltage 2 (V>>)	265 V	-	0.2 s
Sustained Overvoltage (10 minutes)	258 V		3 s
Under-frequency (F<)	47 Hz	1 s	2 s
Over-frequency (F>)	52 Hz	-	0.2 s
Active anti-islanding (loss of mains)	-	-	2 s
Reconnection delay	60 s		

The inverter's power quality response mode shall be "Fixed Power Factor" at unity and shall not export VArs during normal operation.

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.

Embedded Generator Negotiated Connection Service (Voltage Response Modes Enabled)

Applies To

Inverter installation installed capacity is greater than 30 kVA up to 200 kVA (3 phase).

Central Protection Requirements

The central protection relay shall have the following set points and disconnection times:

Protective Function	Protective Function Limit	Maximum disconnection Time
Undervoltage (V<)	180 V	2 s
Overvoltage 1 (V>)	260 V	2 s
Sustained Overvoltage (10 minutes)	255 V	15 s
Under-frequency (F<)	47 Hz	2 s
Over-frequency (F>)	52 Hz	2 s
Vector shift	8°	2 s
Rate of Change of Frequency (ROCOF)	1 Hz/s	2 s
Current Unbalance	21.7 A	2 s
Reconnection Delay	60 s	

Inverter Protection Requirements

The inverter will have the following set points and disconnection times aligned with AS4777.2:2015:

Protective Function	Protective Function Limit	Trip delay Time	Maximum disconnection Time
Undervoltage (V<)	180 V	1 s	2 s
Overvoltage 1 (V>)	260 V	1 s	2 s
Overvoltage 2 (V>>)	265 V	-	0.2 s
Sustained Overvoltage (10 minutes)	258 V		3 s
Under-frequency (F<)	47 Hz	1 s	2 s
Over-frequency (F>)	52 Hz	-	0.2 s
Active anti-islanding (loss of mains)	-	-	2 s
Reconnection delay	60 s		

The inverter's **volt-watt** response values must be set at:

Reference	Voltage (V)	Active Power (P/Prated) %
V1	207 V	100%
V2	220 V	100%
V3	253 V	100%
V4	259 V	20%

The inverter's **volt-var** response values must be set at:

Reference	Voltage (V)	Reactive Power (VAr % rated VA)
V1	208 V	44% leading (export VAr)
V2	220 V	0%
V3	241 V	0%
V4	253 V	44% lagging (import VAr)

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.