



Company Standard

Conditions Governing the Connection and Operation of Mini-Generation

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Foreword

This document has been produced to facilitate a more efficient connection of inverter connected generation in the premises of LV connected demand customers, with an installed generation capacity above the levels set out in Micro-Generation ([DTIS-230206-BRL](#)), and up to an installed capacity of 72 A single-phase (c. 17 kVA) or 72 A per phase three-phase (c. 50 kVA), termed 'Mini-Generation'.

In this document the requirements for Mini-Generation installations, set out in 'Conditions Governing Connections to the Distribution System at MV' ([DTIS-250701-BDW](#)), have been simplified, with the main changes being:

- Use of Type Tested equipment by [I.S. EN 50549-1](#)
- Requirement for witness testing removed (except on an audit basis)
- Interface protection requirements now to be met by the customer equipment provided, installed, and commissioned with the Mini-Generation installation, and not requiring a separate interface protection panel i.e. using inverter integrated protection
- Size of largest single-phase unit permitted on three-phase connection is defined
- Size of largest single-phase generator which can be used on single-phase network is defined
- Requirements for use of Export Limiting Schemes for Mini-Generation installations are provided in the associated document 'Conditions Governing the Connection and Operation of Export Limiting Schemes' ([DOC-250221-GBT](#))

Generation which is not categorised as Micro-Generation ([DTIS-230206-BRL](#)) or Mini-Generation ([DOC-030221-GAP](#)) is covered under 'Conditions Governing Connection to the Distribution System at MV' ([DTIS-250701-BDW](#)).



Note: Non-inverter connected generation connections are not covered by this Mini-Generation standard

i. Scope

This document specifies the connection requirements for inverter connected generation installations of up to 72 A (single-phase or three-phase) installed capacity in demand installations connected to the LV distribution system.

It does not cover synchronous or induction generation connections, to which the existing policy 'Connections Governing Connections to the Distribution System' ([DTIS-250701-BDW](#)) continues to apply.

The following documents cover the conditions governing the connection and operation of generator installations to the Distribution System Operator (DSO) network:

Table 1: Conditions governing the connection and operation of generator installations documents

Generation Installation	Document Title	Ref. No.
Micro-Generation: Up to and including 25 A single-phase / 16 A three-phase (c. 6 kVA/11 kVA, LV)	Conditions Governing the Connection and Operation of Micro-Generation	DTIS-230206-BRL
Mini-Generation: (Inverter Connected) Above Micro-Generation, up to and including 72 A single-phase / 72 A three-phase (c. 17 kVA/50 kVA, LV)	Conditions Governing the Connection and Operation of Mini-Generation	DOC-030221-GAP
Export Limitation Schemes for Mini-Generator installations Up to and including 72 A three-phase (c. 50 kVA, LV)	Conditions Governing the Connection and Operation of Export Limiting Schemes	DOC-250221-GBT

All other generation	Conditions Governing Connections to the Distribution System at Medium Voltage	DTIS-250701-BDW
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ii. Mandatory References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

Table 2: Mandatory References

Document No.	Title
DOC-230206-BRL	Conditions Governing the Connection and Operation of Micro-Generation
DTIS-250701-BDW	Connections Governing Connection to the Distribution System at Medium Voltage
DOC-060416-EEY	Distribution Code
DOC-250221-GBT	Conditions Governing the Connection and Operation of Export Limiting Schemes
I.S. EN 50549-1	Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network - Generating plants up to and including Type B
I.S. EN ISO/IEC 17065	Conformity Assessment – Requirements for bodies certifying products, processes and services
DOC-030303-AEN	ESB Networks National Code of Practice for Customer Interface
I.S. 10101	National Rules for Electrical Installations

1. Requirements for Mini-Generation Installations on ESB Networks

1.1 About this document

This document sets out ESB Networks standard on the connection and operation of inverter connected Mini-Generation as defined in [Section 1.2](#).

Generation connections which are not covered in either the Micro-Generation document ([DTIS-230206-BRL](#)) or in this Mini-Generation document (DOC-030221-GAP), are by default covered in 'Conditions Governing Connections to the Distribution System at MV' ([DTIS-250701-BDW](#)).

1.2 Definitions

1.2.1 Mini-Generation

For the purposes of this document, Mini-Generation is defined as a source of inverter connected electrical energy and all associated equipment, in the following ranges:

- Greater than 25 A up to and including 72 A¹ at low voltage [230 V]², when the DSO network connection is single-phase
- Greater than 16 A up to and including 72 A at low voltage [230 V/400 V]³, when the DSO network connection is three-phase

and designed to operate in parallel with the DSO Network.



Note: No more than three individual 25 A single-phase generators connected evenly over the three phases shall be installed on a three-phase connection

Where multiple generating sources [of the same or varied technologies] are on the same site and share access to the same DSO network connection point, the aggregate rating shall not exceed:

- 72 A⁴ single-phase at low voltage, when the DSO network connection is single-phase
- 72 A per phase at low voltage, when the DSO network connection is three-phase

1.2.2 Energy Source Capacity (Generation and energy storage)

Energy Source Capacity is defined as the total capacity, of any Electrical Energy Source(s), expressed in kVA, that is connected through an inverter to a Point of Connection (PoC) to the DSO network.

1.2.3 Installed Capacity:

- Throughout this document reference is made to 'Installed Capacity', for the purpose of defining the scope of the 'Mini-Generation' connection process.

¹ Single-phase up to 72A only available in certain cases.

² c. 6 kVA to c. 17 kVA

³ c. 11 kVA to c. 50 kVA

⁴ Single-phase up to 72 A only available in certain cases.

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- The Installed Capacity shall be the total of the aggregate of the continuous steady state rating of the energy sources' inverters⁵.
 - In cases where the amount of generation or battery export installed behind an inverter is greater than the inverter rating, the Installed Capacity shall still be taken as equal to the inverter rating (as the inverter limits the power seen at the Point of Connection).
 - On a three-phase connected installation, no more than 3 x 25 A⁶ single-phase generators shall be installed. Any generation in excess of this shall be three-phase generation. Three-phase units shall have a maximum unbalance between phases no more than 25 A.
 - In some parts of the country where provision of three-phase network is costly, it may be possible to connect up to 72 A on a single-phase network; This shall be subject to a satisfactory technical assessment.

1.2.4 Maximum Export Capacity (MEC):

The Maximum Export Capacity (MEC) is defined as the maximum power, expressed in kVA, that is permitted by ESB Networks to transfer from the Customer's Point of Connection to the DSO Network.

The MEC shall not be greater than the Maximum Import Capacity (MIC).

The installed inverter capacity (deemed to be the amount of generation seen by the system) cannot be greater than the MEC, unless there is an Export Limiting Scheme in place (see [Section 1.2.5](#)), because in the event of the customer load being turned off, then all the installed energy sources may export unconstrained onto the grid resulting in standards being breached.

1.2.5 Export Limiting Scheme

See 'Conditions Governing the Connection and Operation of Export Limiting Schemes' ([DOC-250221-GBT](#)) (available on www.esbnetworks.ie) applicable for generator installations from 11 kVA up to 50 kVA.

1.2.6 Distinction between Installed Capacity and Maximum Export Capacity:

Throughout this document reference is made to Installed Capacity for Mini-Generation.

MEC is distinct from and is separately defined in the ESB Networks Connection Agreement.

These definitions make no explicit reference to any specific form of generating technology (other than that it is **inverter connected**).

⁵ Generation and battery export

⁶ c. 6kVA

2. Applicable Technical Standards

2.1 I.S. EN 50549-1

All installed Mini-Generators shall comply with [I.S. EN 50549-1](#) with the specific Irish protection settings, set out in [Section 2.2](#) of this document.

2.2 Interface Protection Settings

The protection settings for Mini-Generation shall be those stated in Table 4M of 'Conditions Governing Connection to the Distribution System at Medium Voltage'⁷ ([DTIS-250701-BDW](#)), **except** in the case of overvoltage protection, where 2 stage settings, with higher settings shall be required as set out in [Table 3, Annex A](#).

Interface protection should be checked by the customer at regular intervals (but at least every 5 years) and on any occasion when revised protection settings are advised by ESB Networks.

Where changes to protection settings are required, the customer shall be notified in writing by ESB Networks. The customer shall then confirm the required changes have been made within twenty working days to dsominigeneration@esb.ie.

⁷ Conditions Governing Connection to the Distribution System at Medium Voltage; Connections at MV and 38kV; Embedded Generators at LV, MV and 38kV

3. Common Considerations

3.1 Metering

Metering requirements are outside the scope of this document, and are covered on the Mini-Generation section on the ESB Networks' website.

3.2 Interface Protection

In accordance with [I.S. EN 50549-1](#), each Mini-Generator shall have interface protection, as specified, which will include the following elements:

- Undervoltage protection
- Overvoltage protection
- Underfrequency protection
- Overfrequency protection
- Means to detect island situation

Settings shall be as specified in [Section 2.2](#).

3.3 Cease energise / Disconnection

The interface protection shall cease energisation of the DSO network when any parameter exceeds the applied operating setting.



Automatic disconnection shall be required in case of any hardware malfunctioning.

3.4 Mechanical / solid-state switching device

Cease-energise-in-response-to-an-interface-protection operation shall be achieved either by the separation of mechanical contacts or by the operation of a suitably rated solid-state switching device. Where a solid-state switching device is used the Mini-Generator shall monitor the proper functioning of the device. In the event the solid-state switching device fails to interrupt the current, the Mini-Generator shall disconnect. The solid-state switching device shall be specified in accordance with the over-voltage category of the Mini-Generator as specified by the manufacturer and have a leakage current in the off-state of not more than 0.1 mA.

3.5 Accessibility of Isolation Switching Devices

Under the [I.S.HD 384](#) series there is a requirement that means shall be provided to enable a generator set to be isolated from the public supply and the means of isolation shall be accessible to ESB Networks at all times. However, it is recognised that Mini-Generators are a special case by virtue of their type testing and potentially large numbers, therefore it is acceptable to dispense with the isolator to be accessible at all times, subject to the provision of two means of automatic disconnection, with a single control. At least one of the means of disconnection shall be afforded by the separation of mechanical contacts.

3.6 Location of the Interface Protection

The interface protection shall be incorporated, either within the Mini-Generator or afforded by separate devices. In either case, the interface protection shall comply with standard [I.S. EN 50549-1](#), and the manufacturer of the Mini-Generator shall declare that the combined devices fulfil these requirements as part of the application process.

3.7 Changing settings of the interface protection

The interface protection settings shall only be altered, from those in place at the time of commissioning, with the written agreement of ESB Networks, or where ESB Networks instruct the customer to update the settings to required levels, and then only in accordance with the manufacturer instructions.

It shall not be possible for the user to alter the interface protection settings without the use of special tools or techniques.

3.8 Means to Detect Islanding situation

Means to detect islanding situations (known as 'Loss of Mains' or 'anti-islanding protection') shall operate to ensure cease energising or disconnection within the prescribed clearance time irrespective of where, on the DSO network, the interruption takes place, for a generation to load mismatch of 75% and 125% or greater.

This functionality shall be demonstrated and explicitly stated in Type Testing certification.

The operation of this protection at any given site shall not in and of itself, disturb or cause spurious operation of interface protection at any other site.

3.9 Rate of Change of Frequency [ROCOF] immunity requirements

The Mini-Generator module shall stay connected to the distribution system when the frequency of the power system changes at a rate of up to 1 Hz/s. This rate is defined with a sliding measurement window of 500 ms.

This functionality shall be explicitly demonstrated in Type testing. If ROCOF is used as the means of detecting island situations, then the setting for the demonstration of compliance with this clause shall be as close as practical to 1 Hz/s.

3.10 Automatic reconnection after a network outage

The interface protection shall ensure that feeding power to the DSO network shall only commence after the voltage and frequency on the DSO network have been within the limits of the interface protection settings for a minimum of

– 5 minutes for inverter-based systems.

In order to facilitate such automatic reconnection, power input to the interface protection equipment and sensing connections to the interface protection shall be made on the ESB Networks' side of the disconnector (but on the Mini-Generator side of the isolator) that is initiated by the interface Mini-Generator protection. Manufacturers should give consideration to limiting the number of attempted reconnections within any one period of time.

The interface with the DSO network shall not be capable of connecting the generation source to the DSO network if the DSO grid supply is not present and within parameters given in [Section 2.2](#).

Any form of generation whose interface with the DSO network does not comply with this provision, is considered outside the scope of this policy.

3.11 Network sizing considerations

No allowance for import reduction shall be taken into consideration in the determination of the sizing of network components.

All designs shall be based upon the MIC or MEC stated in the application, and the more onerous condition shall determine the design.

3.12 Type testing and certification for Interface protection

Use of Type Tested equipment produced to [I.S. EN 50549-1](#), with interface protection settings as per [Section 2.2](#) certified by a competent supplier and otherwise confirmed by the installer are relied on to ensure that the Mini-Generator meets the requirements set out in this standard.

Accordingly, reliance is placed on a system of type testing and certification, to be operated as outlined below.

Every new Mini-Generator interface type and model, shall satisfy the following conditions:

- Provision of a Type Test⁸ Certificate confirming the requirements of [I.S. EN 50549-1](#) have been met.
- Type tests to confirm that the Mini-Generator meets the requirements of [I.S. EN 50549-1](#) shall be carried out by, or under the supervision of, a recognised test laboratory.
- The Type Test Certificate, or accompanying documentation from the manufacturer, shall specify the Short Circuit Level Psc required at the connection point for conformance with [I.S. EN 61000-3-12](#) for harmonics, in terms of Psc, Impedance $R + jX$, or an Rsc value.
- The individual harmonic currents shall be stated on the Type Test Certificate.
- Labelled with CE Marking to confirm compliance with relevant European Directives.
- During the type-tests, or as subsequently certified by the supplier and confirmed by the installer, interface protection settings on board shall be as contained in [Section 2.2](#).
- The methodology used to carry out the type test shall be as outlined in I.S.EN 50549-10* when it is issued by CENELEC.
- In the interim, the type testing by the test laboratory issuing the Type Test Certificate shall confirm that the requirements of [I.S. EN 50549-1](#) are met, using the test methodology given in [I.S. EN 50438](#) and PrEN 50549-10* where applicable, and otherwise best industry practice .
- A copy of the Type Test Certificates should also be supplied by the Mini-Generator installers, to each customer.

*This document is under development by CENELEC and is unavailable for linkage at this time

3.13 Safety of ESB Networks Personnel

Compliance with this standard, with the National Rules for Electrical Installations ([I.S. 10101](#)), and the ESB Networks Code of Practice at the Customer Interface ([DOC-030303-AEN](#)) with shall be required to safeguard against electrical hazards being presented to persons working on or in close proximity to DSO Network.

⁸ Type test certificate shall be from a body certified to [I.S.EN ISO/IEC 17065](#)

3.14 Labelling

Where an item of equipment contains live parts connected to more than one source of supply, a warning notice shall be fitted in such a position that any person gaining access to live parts is warned in advance of the need to isolate those parts from the various supplies. However, this shall not be required if an interlocking arrangement is provided to ensure that all circuits concerned are isolated.

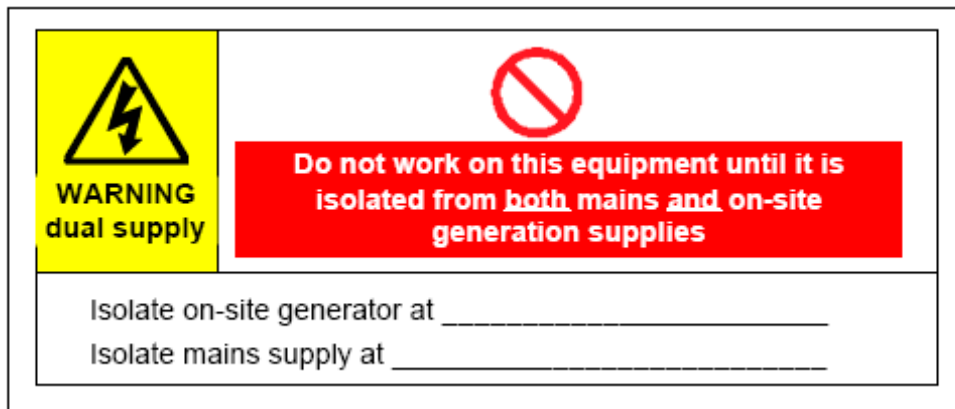
Special attention should be paid to the possibility of the power supply, measuring circuits [sense lines] and other parts not being isolated from the grid when the switching device[s] associated with the interface are open.

As a minimum, warning notices shall be placed:

- At the ESB Networks metering position of a location where a Mini-Generator is installed
- At the consumer unit position of a location where a Mini-Generator is installed
- On all switchboards between the consumer unit and the Mini-Generator itself
- At all points of isolation for the Mini-Generator

A suggested format is given in Figure 1

Figure 1: Suggested format of warning notice



3.15 Voltage control

Subject to agreement with ESB Networks, generators may use voltage related active power reduction as per clause 4.7.3 of [I.S. EN 50549-1](#) to avoid the likelihood of tripping for high voltage events.

ESB Networks may in the future seek to invoke or apply some of the additional voltage control capabilities of the equipment cited in [I.S. EN 50549-1](#). Where this arises, ESB Networks should communicate such proposed changes with industry and stakeholders as effectively as possible. Any applicable changes to the Distribution Code shall be progressed through the Distribution Code Review Panel (DCRP).

3.16 Overvoltage 10 minute mean protection

Generators may create an alert or trip for overvoltage based on a 10 minute average subject to [I.S. EN 50549-1](#) section 4.9.2.4. The overvoltage may be set at 112% of nominal (258 V / 448 V).

4. Connection Offer Process for Inverter Connected Mini-Generation.

4.1 Description

The Mini-Generation process shall require an application for connection to ESB Networks, whereupon a network study shall be carried out locally and the conditions for connection advised in the Connection Offer.

4.2 Implementation of Connection Offer Procedure for Mini-Generation

4.2.1 Application and Connection Offer

For installations in existing premises, the customer shall complete the Mini-Generation installation application form (Form **NC7**, available on www.esbnetworks.ie) and provide with the application form, a Type Test Certificate from a recognised laboratory confirming compliance with [I.S. EN 50549-1](#) for the proposed Mini-Generator, and confirmation that the settings in [Section 2.2](#) have been applied.

The name, e-mail address, postal address and phone number of the Installer shall also be provided.

Following receipt of application and application fee, ESB Networks shall assess the network for the proposed connection and contact the customer with any associated connection limitations or costs (where requested).



No works shall progress until the conditions in the Connection Offer have been met and any ESB Networks construction work has been completed.

4.2.2 Installation of Mini-Generation

Following acceptance of the Connection Offer, and after installation, the installer shall carry out any relevant on-site commissioning tests to ensure satisfactory operation of the generator, with the installation conforming to the National Rules for Electrical Installations ([I.S. 10101](#)) and the ESB Networks Code of Practice at the Customer Interface ([DOC-030303-AEN](#)).

The installer shall also confirm that:

- a) Any applicable on-site commissioning tests have been completed satisfactorily, and;
- b) That interface protection settings are in compliance with [Section 2.2](#) of this document, or as otherwise agreed with ESB Networks, and;
- c) The above is certified by the production of an Installation Confirmation Certificate, in [Annex A](#), signed by the Installer.

These details shall be immediately returned to ESB Networks (email to dsominigeneration@esb.ie) to complete the connection on the DSO system.



Until confirmation of the installation has been received by ESB Networks, the offered MEC (and ELS, if applicable) shall not become active.

The period of validity of the Connection Offers shall be as stated in the Connection Offer

4.2.3 Witness Testing

For quality and auditing purposes, and to the extent that is appropriate for the equipment in question, ESB Networks shall reserve the right to arrange on an audit basis, to carry out witness testing of the relevant elements [under/over voltage/frequency and Loss of Mains] of interface protection. Where this is invoked, this shall be arranged in advance with the installer. If a Mini-Generation installation has been nominated for such witness testing by ESB Networks, it shall not be connected to the network until this witness test is completed. The witness testing requirements shall be as set out in 'Conditions Governing Connections to the Distribution System at MV' ([DTIS-250701-BDW](#)).

Further details on the process are available on the ESB Networks website.

Annex A. (Mandatory) Form NC7-01-R1 - Mini-Generation Installation Confirmation Certificate

Mini-Generation Installation Confirmation Certificate

Form NC7-01-R1

(DOC-171121-HFO)

(Please complete and return to ESB Networks (email to dsominigeneration@esb.ie on connection)

Customer Name (as registered to MPRN): _____

MPRN: _____

Eircode: _____

Generator Manufacturer:		Make:			
Enter Type Test Certificate reference number for the make and model above:		Model No:			
Single/Three Phase:		Single: <input type="checkbox"/> Three: <input type="checkbox"/>			
<i>Table 3: Interface Protection Settings</i>		LV Single Phase	LV 3 Phase	CONFIRM SETTING APPLIED (Y / N)	Deviation Value (if any)
Under Voltage					
Stage 1		29 V 0.5 s	52 V 0.5 s		
Stage 2 (Use if only single stage)		191 V 3 s	332 V 3 s		
Over Voltage					
Pre I.S. EN 50549-1 Installations (Only single stage setting possible)		269 V 0.7 s	468 V 0.7 s		
New I.S. EN 50549-1 Installations (2 Stage Settings)	Stage 1	269 V 70 s	468 V 70 s		
	Stage 2	281 V 0.7 s	488 V 0.7 s		
Under Frequency					
Stage 1 47 Hz		47 Hz 0.5 s	47 Hz 0.5 s		
Stage 2 47.5 Hz (Use if only single stage)		47.5 Hz 20 s	47.5 Hz 20 s		
Over Frequency					
Stage 1 52 Hz		52 Hz 20 s	52 Hz 20 s		
Stage2 52.5 Hz		52.5 Hz 0.5 s	52.5 Hz 0.5 s		
RoCoF		1 Hz / s 0.6 s			
Vector Shift		Not Allowed			

Important Note:

- No deviations from the protection settings in the above table shall be allowed without permission in writing from ESB Networks.

The Mini-Generation installation proposed for connection at the above MPRN:

- a. Conforms to [I.S. EN 50549-1](#) and that a Type Test has been provided;
- b. Details of the Generator interface protection settings installed are as per those applicable in the 'Conditions Governing the Connection and Operation of Mini-Generation' ([DOC-030221-GAP](#)) current at date of application, and the actual settings installed are as listed in the table above.



Until confirmation of the installation has been received by ESB Networks, the offered MEC (and ELS, if applicable) shall not become active.

The timeline for providing this Mini-Generation Installation Confirmation Certificate shall be as stated in the associated Connection Agreement.

I confirm that the Mini-Generation installation quoted in ESB Networks Connection Agreement for the above MPRN is now connected to the DSO network and operational, and any applicable on-site commissioning tests have been completed satisfactorily.	<input type="checkbox"/>
I confirm that there have been no changes to the installation from the above Connection Agreement	<input type="checkbox"/>
I confirm that the above information is accurate.	<input type="checkbox"/>
Installer Name:	
Installer Safe Electric No:	
Installer Mobile No.:	Installer Email:
Installer Address [inc Eircode]:	
Signature:	
Date:	

ESB Networks Witness Test (where applicable)
<i>To be completed by ESB Networks personnel in cases where testing has been witnessed</i>
Confirmation of ESB Networks Witness Test (if witnessed by ESB Networks):
I confirm that the tests specified in the ESB Networks Standard on ELS have been witnessed and the results recorded are as witnessed.
ESB Networks Signature:
Date:

Derogations

No Derogations are recorded against the Requirements of this document.

Terms, Definitions & Symbols Used

For the purposes of this document, the following terms and definitions apply.

Table 5: Terms & Definitions

Term	Definition
Shall	Designates a Company Requirement, hence conformance is mandatory.
Should	Designates a Company Recommendation where conformance is not mandatory, but is recognised as best practice.
May	Designates a Permissive Statement - an option that is neither mandatory nor specifically recommended.

For the purposes of this document, the following symbols apply.



CAUTION: Used to give the end user information on what can happen, why and the consequences of ignoring the caution.



Used to give the end user specific, important information to help complete the task or procedure correctly.



This is a stop or critical point in the procedure.
It contains a rule that shall be followed by the end user.

