



Company Standard

Conditions Governing the Connection and Operation of Export Limiting Schemes at LV and MV

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Introduction

An Export Limiting Scheme (ELS) was initially introduced in December 2021 by ESB Networks to facilitate the installation of inverter-connected generation in excess of the available Maximum Export Capacity (MEC) for Mini-Generation connections only, as defined in 'Conditions Governing the Connection and Operation of Mini-Generation' ([DOC-030221-GAP](#)).

This scheme is now being expanded to include generation installations in certain demand sites outside the scope of Mini-Generation.

i. Scope

This scheme is applicable to generation installations in demand sites at and above the scope of Mini-Generation:

- Generation in LV connected demand sites, at and above Mini-Generation
- Generation in MV connected demand sites
- Application of similar principles at higher voltages is at the discretion of ESB Networks.
- Where used with Mini-Generation, this ELS standard shall apply in conjunction with the 'Conditions Governing the Connection and Operation of Mini-Generation' ([DOC-030221-GAP](#)) standard; it shall be considered an addendum to the Mini-Generation standard, therefore all conditions in the Mini-Generation standard shall also apply.
- Where used with Small Scale Generation, this ELS standard shall apply in conjunction with the 'Conditions Governing the Connection and Operation of Small Scale Generation' ([DOC-030221-HLU](#)) standard; it shall be considered an addendum to the Small Scale Generation standard, therefore all conditions in the Small Scale Generation standard shall also apply.
- Where used with any types of generation other than or Mini-Generation, or Small Scale Generation, it shall apply in conjunction with 'Conditions Governing Connections to the Distribution System at Medium Voltage' ([DTIS-250701-BDW](#)); it shall be considered an addendum to this standard, therefore all conditions in 'Conditions Governing Connections to the Distribution System at Medium Voltage' ([DTIS-250701-BDW](#)) standard shall also apply.

Exporting Limiting Schemes are not applicable for use in Micro-generation installations

The following documents cover the conditions governing the connection and operation of generator installations to the DSO network:

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

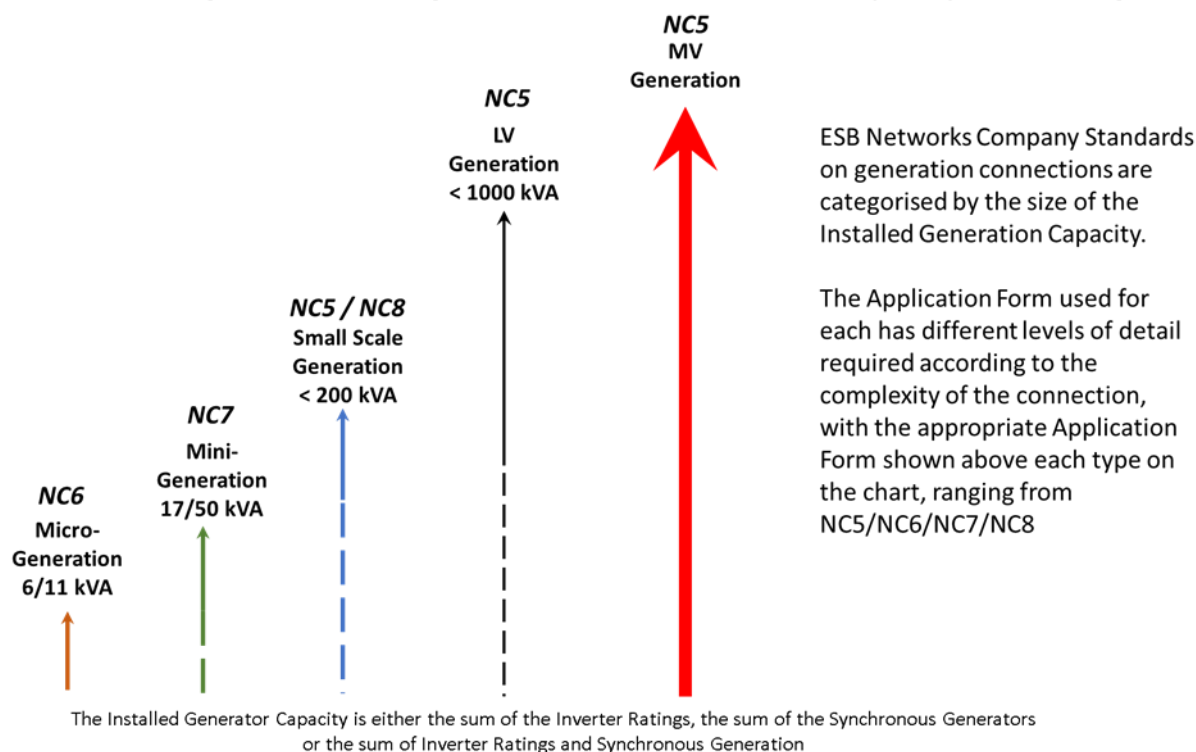
| Generation Installation | Document Title | Ref. No. |
|--|---|---------------------------------|
| Micro-Generation: Up to and including 25 A single phase / 16 A three phase (c. 6 kVA/11 kVA, LV) | Conditions Governing the Connection and Operation of Micro-Generation | DTIS-230206-BRL |
| Mini-Generation: (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 |
| Small Scale-Generation: Above Mini-Generation, up to 200 kVA installed capacity | Conditions Governing the Connection and Operation of Small Scale Generation | DOC-310522-HLU |

| | | |
|--|---|---------------------------------|
| Export Limiting Schemes for Generator installations at LV and MV | Conditions Governing the Connection and Operation of Export Limiting Schemes at LV and MV | DOC-250221-GBT |
| All other generation | Conditions Governing Connections to the Distribution System at Medium Voltage | DTIS-250701-BDW |

** Document in production, link to be added once published

Figure 1: Categories of embedded generation

Generation Categories according to Embedded Generation Capacity and Voltage



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 Reference

| Document No. | Title |
|---------------------------------------|--|
| DOC-030221-GAP | Conditions Governing the Connection and Operation of Mini-Generation |
| DOC-230206-BRL | Conditions Governing the Connection and Operation of Micro-Generation |
| DOC-310522-HLU | Conditions Governing the Connection and Operation of Small Scale Generation |
| DTIS-250701-BDW | Connections Governing Connection to the Distribution System at Medium Voltage |
| DOC-060416-CEY | Distribution Code |
| 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 |

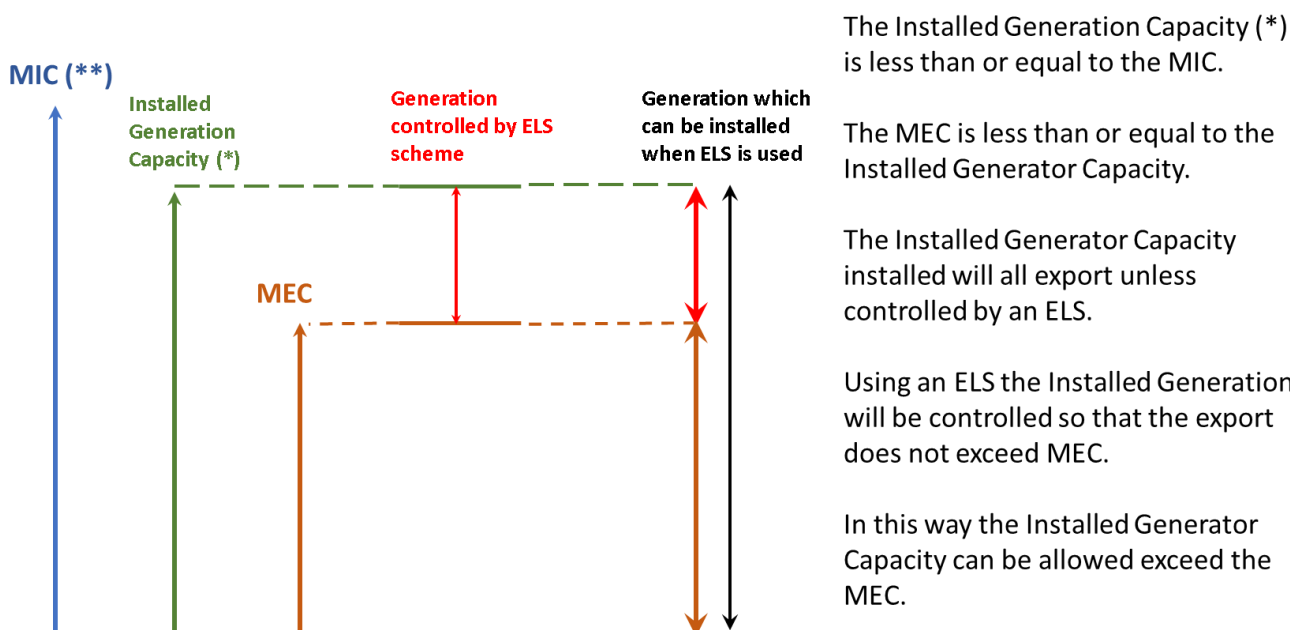
1. Description of an Export Limiting Scheme (ELS)

1.1 Concept

For generation connections within demand sites, if the installed generation capacity is greater than the MEC, then a control system (ELS) is required to ensure that the excess of installed generation capacity does not automatically export and consequently exceed the MEC.

Figure 2: Export Limiting Scheme

How an ELS scheme allows extra Generation to be installed



** At LV, the MIC defines the limit for installed generation capacity, however at MV and above, it is the functional capabilities of the assets associated with the MIC, that inform the possible levels of installed generation capacity for which an application can be made.

Note: At MV and higher voltages, if a customer requires an MEC > MIC then this may be acceptable based on the connection being designed and implemented under the application process current at the time, based on the most onerous impact imposed by either the Installed Generation proposed or the MEC requested, and the impact of MEC on the network .

The Customer's connection has been designed to feed a particular level of load, characterised by a Maximum Import Capacity (MIC).

Installed Generation¹, even if not exporting, will still have an effect on the DSO system regardless of whether it exports power through the connection point or not, as it can generate power system disturbances simply by being connected, or by how it behaves during a fault. Typical disturbances could include harmonics, flicker, short circuit current contribution, etc.

Consequently the actual level of Generation which can be installed is dictated by what the network can accommodate, and because the characteristics of the installed generation are different from those of the load, the level of generation which can be installed may be less than the MIC.

¹ Installed Generation includes any generation which is in parallel operation with the DSO system for longer than 3 minutes at any start-up or shut-down or operates in parallel with the DSO system for longer than 6 minutes during test/maintenance or any other purpose.

Generation which is operation for less than 3 minutes at any start-up or shut-down or operates in parallel with the DSO system for less than 6 minutes during test/maintenance or any other purpose is unlikely to have any material effect on the normal operation of the DSO system and is normally excluded from calculations, although suitable interface protection is required.

It is important to note that a generator will potentially export its full output and if this power is not fully absorbed by customer load, the balance will then be exported through the customer connection and out onto the DSO system. There are limits to what can be exported because of the capability of the DSO system to cope with increased levels of power, including exported power from other generators.

Consequently the most that a customer can export onto the ESB system is set by the Maximum Export Capacity (MEC).

If there is no control over the Installed Generation Capacity (such as with an ELS scheme) then it cannot be allowed to be greater than the MEC, as whatever level of generation is installed will export. So normally the Installed Generation Capacity cannot be greater than the MEC, which in the absence of an ELS scheme is equivalent to the inverter capacity installed. Essentially, the contracted inverter capacity installed acts as a very simple control measure.

However if a customer wishes to install more generation than their MEC level then an export control system is required which prevents excessive generation exports above the allowed MEC.

Such a control system is an Export Limiting System (ELS) which controls both demand and generation such that the balance of net demand and generation does not exceed the MEC. It does this by measuring the exported power and then uses a combination of reducing generation or increasing load to achieve the balance required.

If the ELS fails to operate correctly, then excessive export could occur which could result in plant overload or high voltages, or if the ELS does not work smoothly, could result in voltage dips and flicker.

In order for ESB Networks to be able to allow customers install generation in excess of the MEC it is necessary that ESB Networks can have confidence that the ELS system is fail safe, installed correctly, proven to operate as required and operates in a manner that does not cause power system disturbances. This standard defines such a system.

Where the ELS system installation is not a fail safe design conforming to this document, then a separate Export Limiting Relay (ELR) (or sometimes referred to as a 'Reverse Power Relay') is required

For the avoidance of doubt, in any generator connection where the existing/proposed MEC is zero ('MEC=0' connections), the connection shall also be assessed under this document.

1.2 Non-Exporting Generator Installations ("MEC=0")

Generators which are connected in demand premises to supply customer load, but which do not export still fall into the applicable generation connection standard, as they are simply cases of a generator connection where the MEC =0.

Such connections still have to be studied to ensure that they meet the requirements of the Distribution Code ([DOC-060416-CEY](#)) and other applicable generator connection policy and standard requirements, however the case of export to the system on a continuous basis does not need to be considered, as it should not occur given that the allowed MEC is zero.

With any non-exporting generation, the MEC =0, and hence the installed generation capacity exceeds the MEC and consequently a control system to prevent inadvertent export is always required.

Such a control system can involve an Export Limiting System, or an Export Limiting Relay, or a combination of both.

All MEC=0 connections require export controls as set out above, unless the level of Installed Generation is so low that it is deemed that level of probable export is not material. This is deemed to be case where Installed Generation Capacity is less than 10% of the MIC, and in such cases export control is not required,

For LV, a 'Fail Safe' ELS system (as defined in [Section 5.2.3](#)), or an Export Limiting Relay (ELR) as set out in [Section 2.7](#) is acceptable, and in cases where an ELS system has been found not to operate within the standard requirements, it shall be backed up with an Export Limiting Relay.

At MV and higher voltages, both an ELS and an Export Limiting Relay as backup is required if the Installed Generation Capacity is greater than the MIC, and if less, then either an ELS or an Export Limiting Relay is sufficient.

It is important to note that the level of Installed Generation Capacity for which an application can be made cannot be greater than the MIC for LV connected customers, and for MV and higher voltage connected customers, is dependant on an individual assessment of the capabilities of the connection.

1.3 General concept of ELS system:

An ELS prevents the MEC being materially exceeded. It shall achieve this by ensuring that the customer's generation and load match in such a manner that:

- the customer's MEC is only ever temporarily exceeded by an amount that is no more than 5% of the customer's MEC

and

- the customer's MEC is only ever temporarily exceeded for short periods (<5 seconds)

The Installed Generation Capacity boundaries for the installation of an ELS are related to the generation standard applicable to the installation, as well as the general requirements under the Distribution Code ([DOC-060416-CEY](#)):

- The customer's MEC is less than or equal to the Installed Generation Capacity, which in turn is less than or equal to the MIC,
- and
- For Mini-Generation installations ([DOC-030221-GAP](#)) is the lesser of the MIC and 50 kVA,
- and
- For Small Scale Generation installations ([DOC-310522-HLU](#))
 - is the lesser of the MIC and 170 kVA (where connected from the LV network),
 - or
 - is the lesser of the MIC and 200 kVA (where connected from customer switchroom adjoining an ESB Networks substation)
- Harmonic Standards are not breached by the installation of the extra ELS generation or of the load/generator control system used (thyristor switching of loads to match generation may create significant levels of harmonics, particularly in the case of wave chopping).
 - Operation of the ELS or ELR shall not result in unacceptable voltage dips or flicker. This may require that both generation and load are simultaneously tripped in the event of MEC being breached so as to minimise the impact of either the generation or load fed from generator appearing suddenly on the system.
 - If the customer expects the method of load or generation control outside the levels allowed in the Distribution Code ([DOC-060416-CEY](#)), full details of the switched loads and harmonics should be provided to ESB Networks at time of application



In all cases, the MEC shall be less than or equal to the Installed Capacity.

The Installed Capacity shall be less than or equal to the MIC of the site.

A worked example to illustrate this concept is available in [Annex B](#)

Ultimately, an ELS allows the installed capacity of a Generation site to exceed their customer's MEC, provided the requirements in this standard are met.

In the case where the MEC=0, the allowed ELS then corresponds to the installed capacity of the generation.

1.4 Execution

At MV and higher voltages, if a customer requires an MEC > MIC then this may be acceptable based on the connection being designed and implemented under the application process current at the time, based on the most onerous impact imposed by either the Installed Generation proposed or the MEC requested, and the impact of MEC on the network .

In all other cases, a demand customer's MEC shall never be greater than their MIC and the Installed Capacity of the generation connected shall not exceed the ELS limit agreed with ESB Networks. This also requires that the ELS is not greater than the MIC.

An ELS scheme is unsuitable for, and shall not apply to, any form of standalone generator site, as such a site has no demand load which it can switch to absorb the excess generation.

In cases where no export to the DSO system is contracted or requested, i.e. MEC=0, sites, then any subsequent application for an MEC shall involve an application and a technical assessment using the applicable standard, to assess the allowable levels of MEC and of Installed Embedded Generation where greater than the MEC.

In cases where Installed Generation Capacity is greater than the MEC then a control system such as an ELS or ELR is required to ensure that the MEC is not exceeded. The level of Installed Generation Capacity available is not determined by the ELS scheme, but the ELS scheme ensures that potential problems arising from export in excess of MEC will not occur.

Note MEC=0 is a particular case of a generator connection where the Installed Generation Capacity is greater than the MEC, and consequently the generation and load shall be controlled to prevent the MEC being exceeded, either through use of an ELS, an ELR, or a combination of both.

An ELS is a control system rather than a protection system, and shall meet the following conditions:

- the ELS is 'Fail Safe', i.e. it meets the conditions as outlined in [Section 5.2.3](#) of this document,
- it acts to ensure that the MEC is not exceeded by more than 5% for more than 5 seconds,
- the ELS is documented as performing on site as per the requirements in [Annex C](#) , and
- a product declaration (Manufacturer's ESB Networks ELS Product Declaration) in [Annex D](#) is available

If the ELS does not meet these conditions, an Export Limiting Relay (ELR) shall be required as a back up disconnection device through a dedicated hardwired connection.

At MV and higher voltages, an ELR is also required as backup in all cases, even where a fail safe ELS is required, with the specific loads and generation to be controlled agreed with ESB Networks.

Where an Export Limiting Relay is required as backup to an ELS Scheme, it shall:

- trip the Generator CB on the customer's main distribution board, or
- trip the main incoming CB on the customer's main distribution board, or
- trip a generator interface CB
- or, where required for voltage dip/flicker, trip both generation and associated load so as to minimise system disturbances

within 5 seconds of the export exceeding the MEC for more than 5 seconds.

The detailed tripping arrangements shall ensure that operation of the ELS scheme cannot cause a disturbance on the system.

In all cases of MEC=0, an ELS or Export Limiting Relay is required (both in accordance with this standard) which shall

- trip the Generator CB on the customer's main distribution board, or
- trip the main incoming CB on the customer's main distribution board, or
- trip a generator interface CB
- or, where required for voltage dip/flicker, trip a combination of both generation and associated load so as to minimise system disturbances

within 5 seconds of the export exceeding 11 kVA (three phase) or 6 kVA (single phase).

An Export Limiting Relay is best used in conjunction with some form of export control system, so that the control is more graduated and nuanced, otherwise ELR control is achieved by either tripping the generator or the whole plant, which is likely to be disruptive. In particular, the switching of load and generation shall not cause flicker or other voltage disturbances which are outside the Distribution Code ([DOC-060416-CEY](#)).

In particular, tripping the generator alone will result in all the load previously fed from the generator now suddenly being applied to the DSO system which could cause unacceptable voltage dips or result in the MIC being exceeded. The customer's connecton is not necessarily rated for or capable of supplying load in excess of MIC, and could be damaged by excess load.

For ELS on Mini-Generation, witness testing shall be undertaken by ESB Networks at their discretion, on an audit basis for quality purposes, and, for non-Mini Generation installations, operation of the Export controls (ELS/ELR) shall normally be Witness Tested in conjunction with Witness Testing of the interface protection (e.g. G10).

Confirmation that an ELS is required shall be stated in the applicable application form (application form (Form **NC7** for Mini-Generation installations, Form **NC8** for Inverter-connected Small Scale Generation installations, or Form **NC5** for other installations), available on www.esbnetworks.ie. Results of the commissioning tests carried out by the Installer are required to be submitted to ESB Networks on completion of the installation. Confirmation of installation shall be provided as per [Section 3.2](#) below.

2. Network Requirements

2.1 Existing MEC=0 generation sites seeking a contracted MEC

In cases where no export to the DSO network is currently contracted or required i.e. MEC = 0 sites, then, where applicable, any subsequent application for an MEC shall involve an assessment using the applicable standard and ELS standards, under the application process current at the time.

Mini-Generation:

Additionally, existing MEC=0 Mini-Generation sites with parallel operation generators pre-date the use of [I.S. EN 50549-1](#). However these sites already have interface protection in place which has already been witness tested by ESB Networks in line with the Conditions Governing Connections to the Distribution System at Medium Voltage ([DTIS-250701-BDW](#)) standard, so that subsequent changes in settings shall not normally require any further witness testing by ESB Networks.

Any MEC applied for shall be assessed by ESB Networks, as set out in Conditions Governing the Connection and Operation of Mini-Generation ([DOC-030221-GAP](#)). The existing protection interface arrangement is acceptable, but the new settings in Conditions Governing the Connection and Operation of Mini-Generation ([DOC-030221-GAP](#)) shall now be applied to the interface protection in place, with confirmation that the new settings have been applied provided to ESB Networks.

The requirements of this document; Conditions Governing the Connection and Operation of Export Limiting Schemes (DOC-250221-GBT) shall also be met.

2.2 Level of Installed Capacity

The level of Installed Capacity in excess of MEC (which is equivalent to the size of the installed generation) is set by considering:

- Thermal Limits
- Voltage Limits
- Power System Disturbances, including those during operation of the ELS (e.g. Flicker, Harmonics, Unbalance)
- System Constraints (including impact on SC levels)

For MEC =0 the connection is assessed using the same criteria but with an MEC of zero.

2.3 Requirements of ELS Schemes

While the generation installed generally has constant output, load may vary. This potentially causes a mismatch between varying load(s) and constant generation output; the resultant of which may be greater than the MEC² allowed, thus causing excessive export.

Accordingly, to avoid excessive disruption to the running of the generation and loads, a period of 5 seconds is allowed within which the load or generation shall be adjusted so as to keep export within up to 5% above the MEC level permitted³.

The ELS may be formed using discrete units, which have communication links between the units, connected by either metallic or fibre optic cables. Use of any other means the ELS is not deemed 'fail safe' and shall require installation of an Export Limiting Relay.

To ensure 'fail safe' operation, for any event which could cause the ELS system to maloperate, the total generation output shall be immediately reduced to the MEC. Examples of such failures would include, but not be limited to, communication system failures, power supply failures, internal process control safeguards, etc.

² In the particular case of MEC=0 the levels at which mismatch with the zero MEC allowed shall be no more than 11kVA (three phase) or 6kVA (single phase).

³ The ELS may be greater than the MEC by more than 5%, but during the control operation the mismatch shall be no more than 5%.

For Generation connections a backup disconnection device is required if

- the ELS is not 'fail safe'⁴ or
- if it is incapable of operating to control the export within 5 seconds to no more than 5% above the MEC or
- if MEC=0, where an Export Limiting Relay is required, to ensure that the absolute value of export shall not exceed 11 kVA (three phase) or 6 kVA (single phase) for more than 5 seconds,
- or if a Manufacturer's ESB Networks ELS Product Declaration Form ([Annex D](#)) is not available.
- and in all cases where the customer is MV or higher voltage connected

This shall be an Export Limiting Relay which operates to either trip the total generation at the Main Board or trip the Main CB on the Main Board, or trip the interface generator CB, or trip a combination of generation and loads through a switching scheme initiated by tripping one central switch, but with all via hardwired connections.

Settings on the ELS schemes shall not be capable of being altered by the Customer without the use of special tools or techniques and shall only be changed with the written agreement of ESB Networks.

A description of the ELS implementation, its settings and a single line diagram shall be permanently displayed on site and a copy of the description returned to ESB Networks with the other required connection documentation (Confirmation of Settings, Manufacturer's ESB Networks ELS Product Declaration Form ([Annex D](#)) or details of ELS Relay installed ([Annex C](#))).

In assessing the allowed ELS limits ESB Networks shall require that the ELS operation is acceptable under the following impact criteria on the DSO network taking into account that meeting these criteria shall also require adjustment of the overall Installation Capacity allowed (including that facilitated by the ELS):

2.3.1 Thermal Capacity Limits

Assessment that impact of ELS operation for the expected period does not breach thermal capability of plant.

2.3.2 Current Unbalance

Current unbalance between phases shall not exceed 25 A⁵ (unbalance may arise in controlling loads)

2.3.3 Voltage Capability

During the operation time of the ELS the following limits apply:

➤ LV

It is possible that the full installed capacity could be exported for up to 5 seconds and hence cause a rise in voltage to a level which would be outside standard. Accordingly, the Installed Capacity allowed shall be limited to an amount which does not cause the value of 253 V to be exceeded by more than 1%.

➤ MV

For MV Connected customers the allowable rise in MV voltage shall not exceed the upper MV voltage limits given in Distribution Code ([DOC-060416-CEY](#)) DPC 4.2.1, Table 2.

2.3.4 Power System Disturbances during operation of the ELS

During operation of the ELS there may be consequent variations in net load on site which results in unacceptable levels of flicker, or other disturbances which exceed levels allowed in the Distribution Code ([DOC-060416-CEY](#)). In such cases the ELS shall be modified to bring such disturbances within acceptable limits.

⁴ 'Fail safe' means that even in the event of failure or loss of power to any module, or the failure of communications systems between modules, the ELS system shall correctly limit export to the MEC.

⁵ c. 6 kVA

For Mini-Generation , the overall level of Installed Capacity facilitated by an ELS shall also be such that Harmonic levels are not exceeded, based on an expectation that under [I.S EN 50549-1](#) the harmonic currents for equipment up to 50 kVA are assumed to be acceptable if the Short Circuit level at the connection point is 33 times the installed generation capacity, or is within the impedance limits set out in the Type Test Certificate - otherwise a harmonic study shall be required.

For all other cases details of the Harmonic currents (up to the 50th harmonic) for each generator, plus details of any harmonics created by switching loads using thyristors, shall also be provided to ESB Networks on request, or where the Installed Generation Capacity is in excess of 3.3% of the MIC.

2.3.5 System Constraints

These could include the impact of other generation connections already existing or in process, or system constraints imposed by other upstream restrictions such as HV Station or MV line capacity or other issues (such as impact on Short Circuit level, current and voltage unbalance).

2.4 Maximum Capacity of Actively Controlled Demand

Actively controlled demand used by the ELS, plus the existing demand shall not be allowed to exceed the MIC. In the event of the generation suddenly being disconnected, the load drawn from the DSO network shall not be allowed to exceed the MIC. This limit also reduces the risk of unacceptable frequent voltage changes occurring.

2.5 Power Factor

The Power Factor at the metering terminals shall be maintained as outlined in the Distribution Code ([DOC-060416-CEY](#)), even during operation of ELS.

2.6 Accuracy and Response Rates

The ELS shall detect any excursion and operate to control the overall combination of load and generation such that the net export does not exceed the MEC by more than 5% (or absolute values of 11 kVA (three phase) and 6 kVA (single phase) for MEC=0) for more than 5 seconds during ELS operation.

Ramp up and ramp down rates of generation and load shall be provided by the Customer on request to facilitate any assessment of power quality by ESB Networks.

The published tolerances of the ELS shall be taken into account to ensure that Export Limits are not exceeded. This requires that the setting of the Export Level to which the ELS controls is the MEC less the ELS Accuracy tolerance.

The overall accuracy of the ELS schemes shall be no less than +/-5%, taking into account factors which include, but are not limited to, sensing /measurement errors, processing errors, communication and control errors.

If these accuracy and response rates requirements cannot be met, then an ELR is required, as set out in [Section 2.7](#) below.

2.7 Back up Export Limiting Relay

The ELS Scheme shall operate to smoothly regulate the operation of load and generation to ensure that MEC is not exceeded by 5% for more than 5 seconds and that power disturbances caused by the fluctuating export level do not cause power system disturbances which are out of standard.

An Export Limiting Relay shall be installed as back-up protection in the event that:

- the ELS Scheme is unable to prevent the MEC being exceeded by no more than 5% for a period of no more than 5 seconds,
- or is not 'fail safe'

- or a Manufacturer's ESB Networks ELS Product Declaration Form ([Annex D](#)) is not available
- or in the case of MEC=0, the Export Limiting Relay shall operate to prevent export of more than 11 kVA (three phase) or 6 kVA (single phase) for more than 5 seconds
- For MV and higher voltage metered customers an Export Limiting Relay is always required in addition to the ELS.

At LV where an ELS and ELR are used in series, the ELR is set to prevent the MEC being exceeded by no more than 5% for a period of no more than 5 seconds, and the ELS is set by the customer to coordinate with these settings.

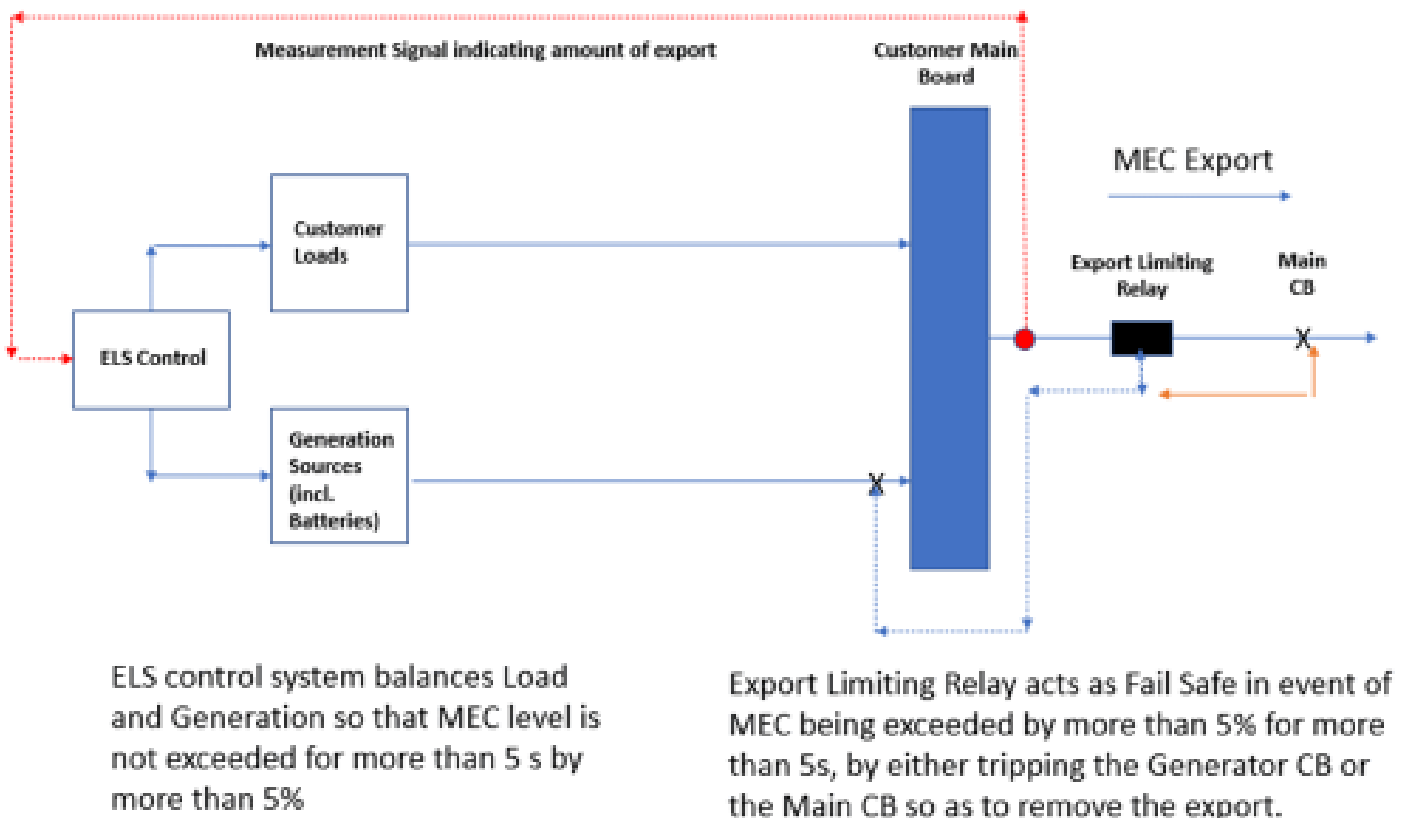
At MV and higher voltages, in cases where an ELS and ELR are both required, then the ELS is set to operate such that the export is prevented exceeding the MEC by no more than 5% for no more than 5 seconds and the ELR is set to coordinate with these settings using protection settings as advised by ESB Networks.

Accordingly, an Export Limiting Relay shall be installed to measure the export onto the DSO network and trip either the Generation CB (where there is one CB controlling all generation) or else the Main CB.

The Export Limiting Relay is a separate relay to limit reverse power (compliant with [IEC 60255](#)) mounted on the Main Customer Switchboard and is not otherwise associated with the generator unit, hence ensuring its independent operation.

Where installed, the accuracy of the Export Limiting Relay shall be +/-3% and shall trip if the MEC is exceeded by 5% for 5 seconds.

ESB Networks reserve the right to retrospectively monitor the schemes for compliance.



Schematic of Export Limitation Scheme

Figure 3: Diagram of ELS Schemes and Export Limiting Relay

3. Connection Offer Process for ELS

3.1 Description

The ELS process shall require an application for connection to ESB Networks using the applicable application form (available on www.esbnetworks.ie):

- Form **NC7** for Mini-Generation installations,
- Form **NC8** for Inverter-Connected Small Scale Generation installations, or
- Form **NC5** in all other cases.

In the application form, the requirement for an ELS shall be stated. A network study shall be carried out locally and the conditions for connection advised in the Connection Offer.

3.2 Installation of ELS for Generation

Following acceptance of the Connection Offer, and after installation, the customer shall carry out on-site commissioning tests, as advised by the manufacturer and in this standard, to ensure satisfactory operation of the generator and ELS, with the installation conforming to National Rules for Electrical Installations ([I.S. 10101](#)) and the ESB Networks National Code of Practice for Customer Interface ([DOC-030303-AEN](#))

The customer shall also confirm that:

- a) Any applicable on-site commissioning tests have been completed satisfactorily and;
- b) that the installation is in compliance with the applicable standard,
 - i. Connections Governing Connection to the Distribution System at Medium Voltage ([DTIS-250701-BDW](#)) or
 - ii. Conditions Governing the Connection and Operation of Mini-Generation ([DOC-030221-GAP](#))
 - iii. Conditions Governing the Connection and Operation Small Scale Generation ([DOC-310522-HLU](#))

and in compliance with this standard 'Conditions Governing the Connection and Operation of Export Limiting Schemes (DOC-250221-GBT), or as otherwise agreed with ESB Networks, and;

- c) The above is certified by the production of:
 - i. A Test Form for Export Limiting Scheme, in [Annex C](#) signed by the customer's Installer, and;
 - ii. Manufacturer's ESB Networks ELS Product Declaration Form in [Annex D](#).

These details shall be immediately returned to ESB Networks, email to:

- dsominigeneration@esb.ie for Mini-Generation
- dsosmallscalegeneration@esb.ie for Small Scale Generation
- dsogenerators@esb.ie for all others

to complete the connection on the DSO system

Until confirmation of the installation as above

i) has been received by ESB Networks,

and

ii) witness testing at ESB Networks' discretion has been completed and verified,

the offered MEC contract (and ELS, if applicable) shall not become active.

The period of validity of the Connection Offer(s) shall be as stated in the Connection Offer.



4. Applicable Technical Standards

All technical standards as listed in [Section 3.2](#) above apply to the installation, in addition to those in this document.

5. Commissioning Tests and Notifications

The Customer shall be responsible for ensuring that the ELS scheme complies with the requirements in this standard.

For Mini-Generation installations, ESB Networks, at its discretion, may choose to witness or not witness the commissioning of the ELS scheme, including demonstration of its 'Fail Safe' operation.

Where ELS commissioning tests are witnessed by ESB Networks, it is expected that witness testing of any new generator installation by ESB Networks should normally take place at the same visit.

Where ESB Networks do not witness tests directly, the customers shall submit a signed copy of the Test Results ([Annex C](#)) to ESB Networks confirming compliance with the ELS requirements in this standard.

For all other generator installations ESB Networks will witness test the successful operation of the ELS during witness testing of the interface protection (e.g. G10), at ESB Networks' discretion.



Until confirmation of the installation as above

i) has been received by ESB Networks,

and

ii) witness testing at ESB Networks' discretion has been completed and verified,

the offered MEC contract (and ELS, if applicable) shall not become active.

The period of validity of the Connection Offer(s) shall be as stated in the Connection Offer.

The product implementing the ELS scheme should have an associated 'Manufacturers ESB Networks ELS Product Declaration' ([Annex D](#)) which confirms that the product implementing the ELS system has been proven to comply with the ESB requirements set out in this document. In the event of such a Declaration being unavailable, an Export Limiting Relay shall also be installed and commissioned to ensure that the MEC is not exceeded during operation of the ELS, with details provided on the form in [Annex C](#).

Satisfactory testing of the ELS implementation shall also require the simulation of the instances where the ELS is expected to operate.

The ELS system provided by the manufacturer should have settings and controls which are tamper-proof. A means of ensuring this is in situ shall be demonstrated during the commissioning test.

A copy of any additional settings associated with the ELS shall be displayed on site alongside the associated protection settings used in the generation installation.

5.1 Precautions to prevent MEC being exceeded during testing

In the case of an ELS scheme, the installed capacity is greater than the MEC. Consequently there is a risk that the MEC could be exceeded during testing. Precautions shall be taken to mitigate this occurring as much as possible. Accordingly, the following precautions should be considered during the test procedure to mitigate this risk:

- (a) Set Export limit to a lower threshold for demonstration purposes
- (b) Temporarily set the export limit to a much lower value than the correct MEC e.g. to 50% or even to zero.
- (c) Restrict the output of the generation (e.g. possibly turn off a number of inverters if generation is multi-inverter).

ELS settings which have been changed for the purpose of demonstrating operation shall be restored and confirmed following completion of testing.

5.2 Commissioning the ELS

5.2.1 Commissioning Sequence

Generation commissioning shall be successfully completed by the Customer or their installer/contractor before ELS commissioning takes place.

The Commissioning sequence by the Customer or their installer/contractor shall be as follows:

1. Implement precautionary measures to ensure that MEC shall not be exceeded during the test [as per [Section 5.1](#)]
2. Carry out Fail Safe Tests
3. Carry out Functional Tests
4. Set Export Limit corresponding to MEC agreed with ESB Networks
5. Verify Export limit is correctly set
6. Enable system operation with ELS settings.

For safety, the tests shall be performed in the above sequence. A subsequent step shall not proceed unless the previous step has been successfully undertaken.

5.2.2 ELS Scheme Modules

5.2.2.1 Power Measurement Unit (PMU)

This module measures the power flow between the customer and the DSO network at the connection point

5.2.2.2 Control Unit (CU)

This unit is part of the ELS system and compares the Exported power measured by the PMU with the MEC. If the MEC is being exceeded the CU sends signals to the Energy Source Interface Units (ESIU) and Demand Control Units (Loads) to adjust them in a manner that brings the exported power back within the MEC within 5s in a manner that does not breach power quality standards.

5.2.2.3 Demand Control Unit (DCU)

The Demand Control Unit is a load controller which can take a particular setting for allowed load and ensure that it is met by either switching load on/off.

5.2.2.4 Communications Hub:

A Communications Hub may also be present if the Demand Control Units, Generating Units are physically separate units linked by a communications cable or other secure link.



In the event of failure of any of the above units or of the physical communications cable between them, the system shall shut down safely within 5 seconds.

5.2.3 'Fail Safe' Tests

The ultimate 'Fail Safe' is the Export Limiting Relay (where required). However, this is acting as a 'back up', and in order to be most effective, it requires the ELS scheme itself to operate correctly. Hence the ELS Scheme shall be tested before the ELR is tested.

To test the correct operation of the ELS Scheme, each of the above units shall be disconnected from its power supply in turn, and the system shown to shut down within 5 seconds. This shall be simulated by disconnecting the power to each module in turn.

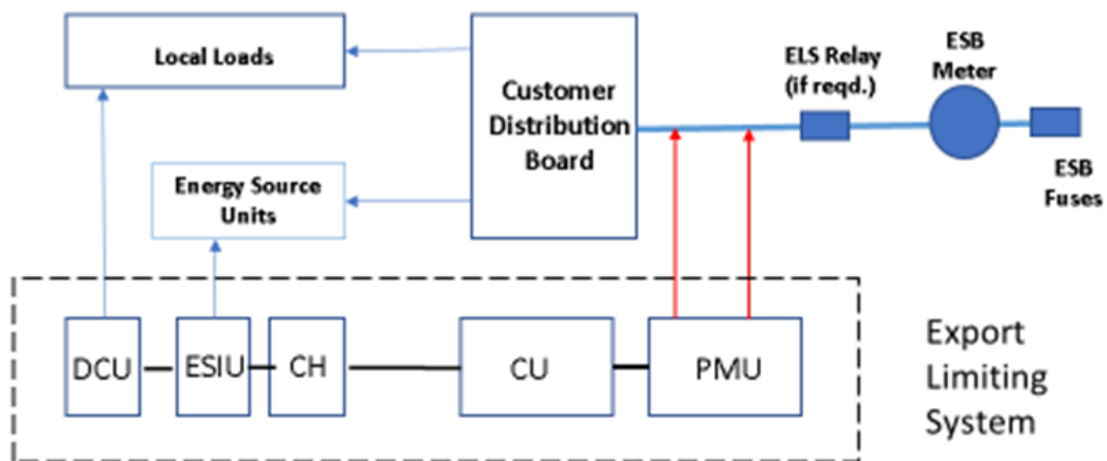
Where all the control modules are installed in one Mini-Generation/ELS unit, it may not be possible to test each control module separately. In such cases, testing for loss of power and loss of communications to the Mini-Generation unit shall suffice. However such tests shall confirm the unit operates correctly and in a fail safe manner.

Following the test of each unit, the system shall be restored to normal operation prior to the commencement of the next test.

Additionally, for a failure of the communication cable between any two modules, the ELS system shall also be demonstrated to 'Fail Safe'. This shall be simulated by disconnecting each communication signal in turn i.e.

- PMU – CU,
- CU – ESIU (at ESIU end),
- ESIU – ESIU Cables,
- CU- CH,
- CU – DCU communications (at DCU end),
- DCU - Load communications cables

Block Diagram of Export Limiting System (ELS), including Export Limiting Relay (ELR)



DCU : Demand Control Unit
ESIU : Energy Source Interface Unit
CH : Communications Hub
CU : Control Unit
PMU : Power Measurement Unit

Figure 4: Block Diagram of ELS implementation

5.2.4 Functional Testing

Functional testing is used to assess that the system operates correctly in specific test scenarios where the correct operation of the ELS is required.

In smaller sites it may be possible to carry out such testing by manually operating the actual loads on site. Where this is not feasible, such as in more dispersed locations, injection testing or verification of real time control of load shall be required.

In particular the correct orientation of the current monitoring connections shall also be checked during testing and on final connection.

5.2.5 Set Export Limit corresponding to MEC agreed with ESB Networks

Following positive verification as per [Section 5.2.4](#), the agreed export limit shall be input.

5.2.6 Verification of Correct Operation of the Functions of the ELS

5.2.6.1 Using Manual Load Control

The sequence required to verify correct operation of the ELS shall be as follows

- a) The export limit is set to a low value
- b) Site loads are manually adjusted up/down

Generator output is adjusted up/down
- c) For successful operation the power exported from the site shall not exceed the export limit in the test by more than 5% for more than 5 seconds before which time the export shall have been reduced to below the export limit set for the test. Successful operation of this test will indicate that the ELS scheme will operate correctly when the export limit is set at the MEC level.
- d) Following successful testing in (c), the Controlled Loads should be turned off while the full generation is running and confirm that the export is limited to not greater than 5% of the MEC for not more than 5 seconds. In practice, the weather conditions may not cause the full output of the generation to be available, but it should be at least 50% of the Installed Capacity.

5.2.6.2 Using Injection testing

Injection Testing is typically used on larger sites with multiple distributed loads.

It involves injecting current into the Power Monitoring Unit from the test kit to simulate a load.

It should be noted that in 5.2.6.1 Manual Testing, the full ELS system is in use, with feedback from the CT's on the incoming connection from ESB to the ELS Control unit, whereas with Injection testing there is no longer a feedback loop with the ELS.

Accordingly this needs to be taken into account during testing:

- (a) The ELS will not see any decrease in export levels as there is no feedback, and the ELS will then operate to reduce the generation units output to the nominal value set and below

- (b) A step change in current needs to be applied from the Test Kit to the PMU to ensure that the the ELS reacts in accordance with the requirements of this standard, and within the correct time and by the correct amount

The required step changes are as shown in NC7-02-R2 in [Annex C](#).

Note: It is important that, following completion of injection testing, that any CT connections which may have been altered during testing are checked to verify their correctness. There are safety issues associated with the installation of CTs and it is expected that this work is carried out by competent and qualified personnel.

5.2.7 Enabling the ELS

Following positive verification as per [Section 5.2.6](#), the ELS shall the be enabled.

5.2.8 Verification of correct operation of an Export Limiting Relay:

The sequence required to verify correct operation of the Export Limiting Relay shall be as follows:

- a) The export limit is set to a low value
- b) Site loads are manually adjusted up/down

Generator output is adjusted up/down

- c) For MEC >0:

For successful operation the power exported from the site shall not exceed the export limit in the test by more than 5% for more than 5 seconds before which time the export relay shall have tripped. Successful operation of this test will indicate that the Export Limiting Relay will operate correctly when the export limit is set at the MEC level.

- d) For MEC =0:

In the case of MEC=0, the Export Limiting Relay shall trip when the export is no greater than 11kVA (three phase) or 6kVA (single phase) for more than 5 seconds.

5.2.9 Enabling the Export Limiting Relay

Following positive verification as per [Section 5.2.8](#), the Export Limiting Relay shall the be enabled



If the unit fails any of these tests, then the unit has failed the full commissioning test and shall not be put into service.

Annex A. (Informative) ELS Concept

An appreciation of an ELS scheme is best illustrated generically in Figure 3, and is also featured in a numeric worked example in [Annex B](#).

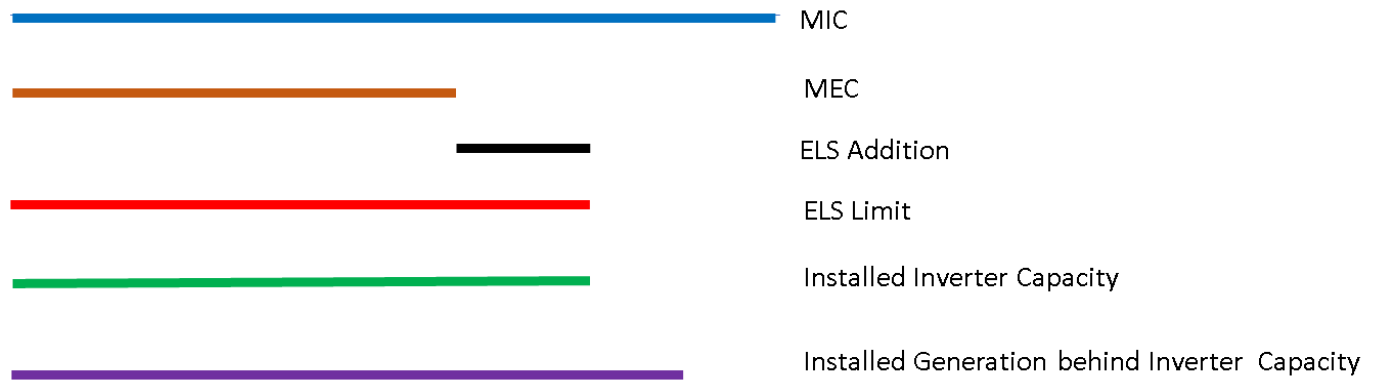


Figure 5: Indicative illustration of an ELS scheme – the lengths of the lines are proportional to the kVA capacities.

Annex B. (Informative) Worked Example of a Mini-Generation ELS Scheme

| | | | |
|------------------------------|--|---------------|-------------------------------------|
| Scenario | Multiple customers with generation are connected to a 33 kVA transformer. One customer now wishes to install 16 kVA of Mini-Generation with a corresponding MEC of 16 kVA. The customer already has an MIC of 20 kVA. | | |
| Considerations & Assumptions | <ul style="list-style-type: none"> The MEC sought (16 kVA) is less than the MIC (20 kVA) Assume there is adequate spare capacity upstream on the MV system and 38 kV system for any extra generation (in practice this will be assessed in each particular case) <p>Let's also assume that the existing generation already connected to the 33 kVA transformer from the other customers is currently 24 kVA</p> | | |
| Assessment | <ul style="list-style-type: none"> The available Thermal Capacity remaining on the 33 kVA transformer is 9 kVA (33 kVA – 24 kVA generation existing). The constraint imposed by the transformer's Thermal Capacity (rating) limits the MEC to no more than 9 kVA <p>Voltage rise depends on:</p> <ul style="list-style-type: none"> How far from the transformer the customer is The impedance of the connection (generally related to distance from the transformer for a particular conductor type e.g. 2 x 95Al bundle conductor) and The total amount of generation flowing through the circuit and causing a voltage rise. <p>This involves a specific calculation to establish, but, as an example, assume that the maximum voltage rise allowed is produced by the addition of 15 kVA of extra generation (if the 9 kVA Thermal Capacity above was not already a limitation).</p> <p>Assume that the Short Circuit level at the connection point is (say) 360kVA so that the amount of generation which can be connected is limited to 10.9 kVA (from $P_{sc}/R_{sc} = 360\text{kVA} / 33 = 10.9$ kVA) based on the generation installed emitting the full allowable quantity of harmonic currents allowed within the I.S. EN 61000-3-12 standard.</p> <p>However, if on the Type Test Certificate it is noted that the particular generator manufacturer proposed actually emits lower levels of harmonic currents than those allowed in the I.S. EN 61000-3-12 standard, and that an R_{sc} of 25 is stated. In such a case then, with a P_{sc} of 360kVA, a generator of up to 14.4 kVA (from $P_{sc}/R_{sc} = 360\text{kVA}/25 = 14.4$ kVA) could be connected without exceeding harmonic limits.</p> <p>From the above analysis the most onerous constraint is selected and this sets the allowable Installed Capacity, which then also corresponds to the MEC:</p> | | |
| | Constraint | Result | MEC Available (Lowest limit) |
| | Capacity Availability at MV & 38kV | Acceptable | |
| | MIC > MEC | Acceptable | |
| | Thermal Capacity limit | 9 kVA | 9 kVA |
| | Voltage Rise limit | 15 kVA | |
| | Harmonic limit | 14.4 kVA | |
| | | | |

| | | |
|--------------------------------|--|---------------|
| | Accordingly, the MEC is set at 9 kVA because the most onerous constraint is thermal capacity, and, as all generation installed can export, then the installed generation capacity also cannot exceed 9 kVA. | |
| Consideration of an ELS Scheme | <p>However application of an Export Limiting Scheme (ELS) in this instance would mean that some of the constraints imposed by exporting power could be reduced and thus allow a greater amount of generation to be installed on site for direct use on site.</p> <p>This is possible because the ELS scheme operates to ensure that the customer load and generation are controlled in such a manner that the net export produced does not exceed the MEC (by more than 5% for more than 5 seconds).</p> <p>Nonetheless, to operate in a practical manner, there is a period where the load and generation are adjusting and thus, in this period, a mismatch of up to the total installed generation could spill onto the network for a short time (<5 seconds allowed) before the control adjustments are completed.</p> <p>However, as this period is so short the impact on thermal capacity is not material, so effectively there is no thermal impact.</p> <p>This means that the remaining restrictions on installed capacity are now:</p> | |
| | Constraint | Result |
| | Voltage Rise limit | 15 kVA |
| | Harmonic limit | 14.4 kVA |
| | <p>The Harmonic Limit of 14.4 kVA is now the most onerous and sets the limit on the Installed Capacity. If a unit with lower harmonic emissions had been proposed then the Voltage Rise limit would then be the determinant, and a slightly larger generator (15 kVA) could be installed.</p> <p>Harmonics, Voltage Rise and Thermal Capacity limits are not exceeded and the Installed Capacity is less than the lesser of MIC (20kVA) and 50 kVA (Mini-Generation).</p> <p>Accordingly, with an ELS scheme applied, 14.4 kVA of Mini-Generation Inverter Capacity can be installed with an MEC of 9 kVA, so that the overall installation is acceptable.</p> <p>Note that 14.4kVA ELS limit is based on Inverter Capacity, as this is what ESB Network responds to, and that behind the inverter a greater amount of generation can be installed e.g. 16kVA.</p> <p>So 16kVA generation could be installed on an Inverter Capacity of 14.4kVA, where the 14.4kVA is set by the ELS Limit.</p> | |

A summary of the relationships between the MIC, MEC, ELS and Inverter Capacity is shown in Figure 4

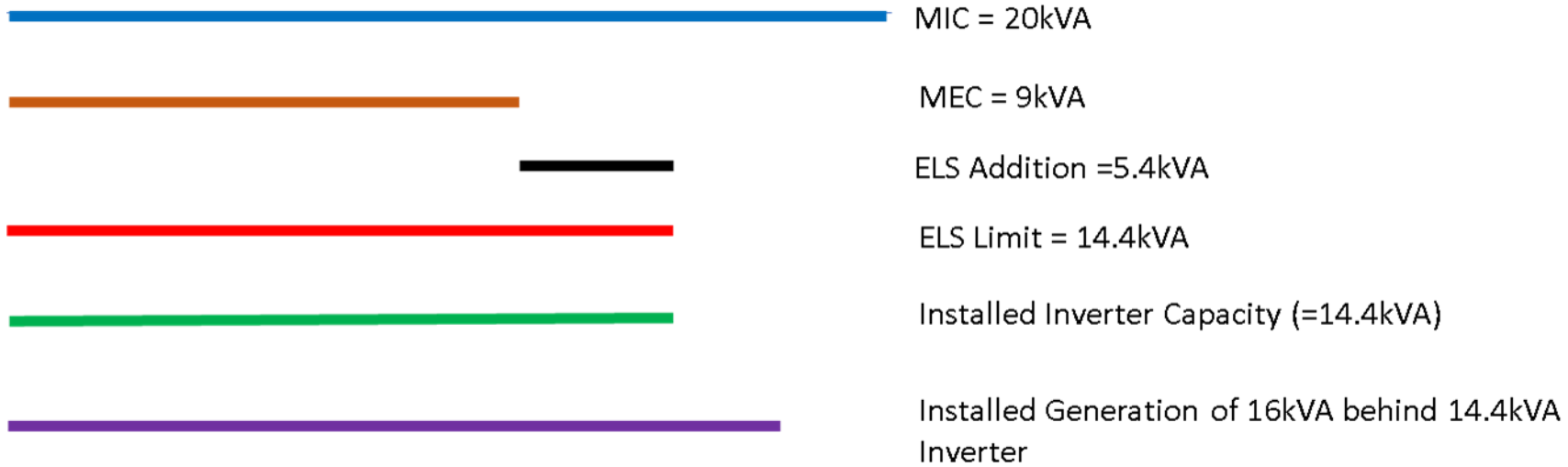


Figure 6: Indicative illustration of an ELS scheme for the worked example.

TEST FORM FOR EXPORT LIMITING SCHEME

FORM NC7-02-R2

ESB Networks DAC requires the information requested on this application form to manage your electricity supply connection. As the Distribution System Operator, this information is also required to enable ESB Networks DAC to manage the electricity network. The data controller is ESB Networks DAC. Please refer to our privacy policy at <https://esbnetworks.ie/privacy>

TEST FORM FOR EXPORT LIMITING SCHEME (ELS) FOR SUBMISSION TO ESB NETWORKS

All mandatory requirements in this form are as those required by ESB Networks Standard 'Conditions Governing the Connection and Operation of Export Limiting Schemes at LV and MV' (DOC-250221-GBT)
Please complete Parts 1, 2 and 3 below. Please complete and return to ESB Networks on completion of the tests to:
dsominigeneration@esb.ie for Mini-generation installations;
dsosmallscalegeneration@esb.ie for Small Scale Generation installations;
dsogenerators@esb.ie for installations where no MEC is required (MEC=0 Sites).

PART 1: CUSTOMER AND INSTALLER DETAILS

| | |
|---|--|
| MPRN (Meter Point Registration Number): | <input style="width: 90%;" type="text"/> |
| MEC (as limited by ELS system) (kVA): | <input style="width: 60%;" type="text"/> Installed Inverter Capacity (kVA): <input style="width: 30%;" type="text"/> |
| Customer Name: (as registered to MPRN) | <input style="width: 98%;" type="text"/> |
| Address of ELS installation: | <input style="width: 98%;" type="text"/> |
| | <input style="width: 98%;" type="text"/> |
| | <input style="width: 98%;" type="text"/> |
| | Eircode <input style="width: 100px;" type="text"/> |
| Installer (Safe Electric No): | <input style="width: 90%;" type="text"/> |
| Installer Name: | <input style="width: 98%;" type="text"/> |
| Installer Address: | <input style="width: 98%;" type="text"/> |
| | <input style="width: 98%;" type="text"/> |
| | Eircode <input style="width: 100px;" type="text"/> |
| Installer Mobile No: | <input style="width: 90%;" type="text"/> |
| Installer E-mail: | <input style="width: 98%;" type="text"/> |

PART 2: INFORMATION TO BE PROVIDED (PLEASE INDICATE THE APPROPRIATE ANSWER BELOW)

| Descriptions: | Data: |
|---|--|
| Block/Single Line Diagram of ELS control unit and associated load and generator connections attached? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Detailed description of the fail safe functionality, indicating correct operation under individual failure conditions (loss of communications, power failure, internal fault detection etc) attached? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Maximum Export Capacity (MEC) agreed with ESB Networks (as set out in the Connection Agreement): | _____ kVA |
| Export Limiting Scheme setting: | _____ kVA |
| Maximum Import Capacity (MIC): | _____ kVA |
| Has the Manufacturers ELS Product Declaration been submitted with the Mini-generation application form for the above MPRN? or If Manufacturer's ELS Product Declaration is unavailable, confirm that Export Limiting Relay (ELR) has been installed | Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Confirm that ELS Communication Links are metallic or fibre (as per Section 2.3 of DOC-250221-GBT), and that the communications and controls system operate to limit the exported power to not exceed the MEC level by more than 5% within 5 seconds. or If ELS Communication Links are not metallic or fibre, confirm that an ELR has been installed | Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Confirm that the ELS is 'Fail Safe' and that failure of any module or of the communication links, or loss of power to any module, the ELS scheme shall limit the export power to not exceed the MEC by more than 5% within 5 seconds, and that this has been tested on site in line with Section 5.2.3 of DOC-250221-GBT | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Confirm that the ELS operates to limit the exported power to not exceed the MEC by more than 5% within 5 seconds | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| In cases where an ELR is installed, confirm that if the exported power is greater than the MEC by 5% for more than 5 seconds, that the ELR disconnects the generation. or If MEC=0, confirm that any exported power will not exceed 6kVA (single phase) or 11kVA (three phase) for more than 5 seconds. | Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> |

Annex D. (Mandatory) Form NC7-03-R1 - Manufacturer's ELS Product Declaration for ESB Networks



This form shall be accompanied by a declaration of compliance conformity from the Quality Control Manager at the factory of manufacture,

This declaration of compliance conformity shall state the tests and requirements in the 'Manufacturer's ELS Product Declaration for ESB Networks' have been completed satisfactorily in accordance with the factory's quality control process.

The declaration of compliance conformity certificate should be stamped, signed and dated by the factory and have the 'Manufacturer's ELS Product Declaration for ESB Networks' form attached.

It is a copy of the original form from the factory that is to be submitted with each connection application.



MANUFACTURER'S ELS PRODUCT DECLARATION FOR ESB NETWORKS FORM NC7-03-R1

ESB Networks DAC requires the information requested on this form to manage your electricity supply connection. As the Distribution System Operator, this information is also required to enable ESB Networks DAC to manage the electricity network. The data controller is ESB Networks DAC. Please refer to our privacy policy at <https://esbnetworks.ie/privacy>

All mandatory requirements in this form are as those required by ESB Networks Standard 'Conditions Governing the Connection and Operation of Export Limiting Schemes' (DOC-250221-GBT)

'Conditions Governing the Connection and Operation of Export Limiting Schemes' (DOC-250221-GBT) defines the technical design requirements for Export Limitation Schemes which limit the net site export to below an agreed maximum and are installed on the Customer's side of the Connection Point.

While DOC-250221-GBT does not describe a type test procedure, it does describe a number of system requirements. This document describes how the ELS product (outlined in Part 1 below) performs relative to key ESB Networks ELS requirements.

Please complete Parts 1 to 9 below

PART 1: PRODUCT DETAILS

| | |
|------------------|------------|
| Name of Product: | Model No.: |
| Manufacturer: | Make: |



Where Manufacturer's ESB Networks ELS Product Declaration Form is unavailable an Export Limiting Relay shall be installed as per ESB Networks Standard 'Conditions Governing the Connection and Operation of Export Limiting Schemes' (DOC-250221-GBT)

PART 2: DESCRIPTION OF OPERATION

ESB Networks ELS Requirement: A description of the scheme, its settings, and a single line diagram shall be permanently displayed on site.

When installed, the ELS product (as outlined in Part 1) operates as described below:

Please insert details of operation below or if attached as PDF to this form tick here:

PART 3: POWER QUALITY REQUIREMENTS

ESB Networks ELS Requirements:

Where the ELS product (as outlined in Part 1) relies on power electronics (e.g. Converters etc) to control the load it shall also provide information demonstrating compliance with the harmonics standards ([IS_EN 61000-3-2](#) and/or [IS_EN 61000-3-12](#)) or provide data on the harmonic currents produced in accordance with the format in the Distribution Code i.e. individual harmonic current and Total Harmonic Distortion.

It is necessary to confirm the ELS product(as outlined in Part 1) complies with harmonic standards cited in the Distribution Code and product standards cited in [IS_EN 50549-1](#).

Yes No

The Manufacturer (as outlined in Part 1) confirms that the ELS product (as outlined in Part 1) complies with the requirements of the harmonics standards listed above or that the harmonic data has been provided.

PART 4: SYSTEM SCHEMATIC

The ELS product (as outlined in Part 1) is formed of the following main elements:

Document the main elements and provide a system schematic or if attached as PDF to this form tick here:

1. Main elements:

2. System Schematic

PART 5: COMPONENT INTERCONNECTION/FAILSAFE OPERATION

ESB Networks ELS Requirements: The ELS product (as outlined in Part 1) may be formed of discrete units or integrated into a single packaged scheme. Where discrete units are used, they should preferably be interconnected using metallic or fibre optic cables. Other means of connection such as Wi-Fi are not deemed 'Fail Safe' and require installation of Export Limiting Relay. Irrespective of the media used for interconnecting between the discrete units, if the communication path fails the generation output shall be reduced to the allowed MEC within 5 seconds time to prevent the Agreed Export Capacity from being exceeded.

Description of the fail-safe functionality (Interruption of sensor signals, disconnection of load, loss of power, internal fault detection etc.)

5.1 Describe Component Interconnection here:

Text or diagram or if attached as PDF to this form tick here:

5.2 System Fail Safe Test Results:

Please indicate appropriate answer

| No. | Test | System Response | Time <5s | Pass |
|-----|---|-----------------|--|--|
| 1 | Remove Power Supply to PMU | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 2 | Remove Power Supply to CU | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 3 | Remove Power Supply to all Energy Source Units | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 4 | Remove power Supply to all DCUs | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 5 | Remove Power Supply to all Communication Hub Switches | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 6 | Unplug PMU- CU Communications Cable | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 7 | Unplug CU – ESIU Communications Cable (at ESIU end) | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 8 | Unplug all ESIU –Communication Cables in turn | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 9 | Unplug CU – DCU Comms. Cable for each DCU unit (at DCU end) | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 10 | Unplug DCU – Load Comms cable | | Yes <input type="checkbox"/> No <input type="checkbox"/> | Yes <input type="checkbox"/> No <input type="checkbox"/> |

The purpose of the 'Fail Safe' Tests is to ensure that if any part of the ELS fail, the exported power does not exceed the MEC by more than 5% for more than 5 seconds.

It is a fixed requirement that at no time during the 'Fail Safe' sequence shall the exported power rise above the MEC by more than 5% for more than 5 seconds.

PART 6: ACCURACY AND RESPONSE TIME

ESB Networks ELS requirements:

The overall accuracy of the ELS product (as outlined in Part 1) with regard to measurement and control of MEC shall be determined by the manufacturer of the system and published within its operating manual. In carrying out the functional tests these tolerances shall be taken into account.

Functional testing – Injection testing

Export limit conditions can be simulated by temporarily connecting the PMU to a calibrated injection test set.

When using an injection test set, there is no feedback loop between the ELS product (as outlined in Part 1) and the injection test set. This has two significant implications for the test process:

1. As soon as the ELS begins to operate, because it sees no corresponding decrease in export levels, the control loop continues running until the Energy Source Units output is reduced to the programmed export capacity or below.
2. To ensure that the ELS is reacting by the correct amount and within an acceptable time period, a step change needs be applied by the test set to the PMU.

The following Step Change test sequence shall be performed:

Please indicate appropriate answer

| No. | Test | Step Change Final Value | Outcome | Pass / Fail |
|-----|------------------------------|--|-----------------|---|
| 1. | Step change A 95% to 105% | Export = 105% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | Step change A 95% to 110% | Export = 105% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | Step change A 95% to 120% | Export = 105% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| 2. | Step change B 95% to 105% | Export = 110% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | Step change B 95% to 110% | Export = 110% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | Step change B 95% to 120% | Export = 110% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| 3. | Step change C 95% to 105% | Export = 120% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | Step change C 95% to 110% | Export = 120% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | Step change C 95% to 120% | Export = 120% of programmed export limit value | At 95% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 100% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |
| | | | At 110% Voltage | Pass <input type="checkbox"/> Fail <input type="checkbox"/> |

The procedure for performing the test is as follows:

- Initially apply 100% of nominal voltage and inject current (at unity power factor) to mimic an exported Active Power equivalent to 95% of the export limit setting. Check that the ELS product(as outlined in Part 1) does not operate.
- Step up the current to give an export Active Power equivalent to 105% of the export Active Power limit (for Test A), Check that change in export level is "seen" by the PMU.
- Check that the Active Power exported by the generation reduces to a value at least 5% below the export limit setting within the specified reaction time. The test shall be repeated at the maximum statutory voltage (i.e. at 110% of nominal voltage at LV) and also at the minimum voltage limit (i.e. 90% of nominal voltage for LV connections).
- All the above tests shall also be repeated for step increases from 95% to 110% of the export limit and from 95% to 120% of the export limit as detailed above.

When injection testing is complete, the correct orientation of any current monitoring connections (including CT orientations) which may have been removed for the test shall be checked and verified as correct.

PART 6A: CONFIRMATION OF OPERATION OF ELS TO LIMIT EXPORT AS REQUIRED

ESB Networks ELS requirements:

The ELS product(as outlined in Part 1) shall detect an excursion and reduce the export to the MEC or less, within 5 seconds.

Under normal operating conditions, the ELS product (as outlined in Part 1) response time is less than 5 seconds.

Under loss of communications, or loss of power to any part of the ELS product (as outlined in Part 1), response time is less than 5 seconds.

| | |
|---|--|
| Operation of above is confirmed | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Operating Manual is available | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| The settings applied to ELS product(as outlined in Part 1) have taken account of the published (DOC-250221-GBT) tolerances to ensure the required export limits and voltage limits shall be maintained. | Yes <input type="checkbox"/> No <input type="checkbox"/> |

PART 7: PASSWORD PROTECTION

ESB Networks ELS requirement:

| | |
|--|--|
| Once installed and commissioned, the ELS product(as outlined in Part 1) settings shall not be capable of being readily altered by the Customer and shall only be changed with the written agreement of ESB Networks. | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| All settings of the ELS product(as outlined in Part 1) are password protected and cannot be altered by the customer. | Yes <input type="checkbox"/> No <input type="checkbox"/> |

PART 8: INSTALLATION REQUIREMENTS

ELS Installation Requirements for ELS Product(as outlined in Part 1):

Please insert installation requirements or if attached as PDF to this form tick here:

PART 9: MANUFACTURERS ELS PRODUCT DECLARATION FOR ESB NETWORKS

ESB Networks ELS requirement: Once installed and commissioned, the scheme settings shall not be capable of being readily altered by the Customer and shall only be changed with the written agreement of ESB Networks.

The ELS product (as outlined in Part 1) complies with the 'Conditions Governing the Connection and Operation of Export Limiting Schemes' (DOC-250221-GBT) when installed and commissioned in accordance with the product documentation.

Manufacturer's (as outlined in Part 1) Representative Details

Representative Name: _____

Title: _____

Email: _____

Contact Telephone Number: _____

Signature: _____

Date: _____

PLEASE REMEMBER!
DON'T BUILD UNDER OR NEAR ELECTRICITY WIRES
STAY SAFE STAY CLEAR
OF ELECTRICITY WIRES
ESB NETWORKS DAC



ESB Networks DAC
Directors: Jerry O'Sullivan (Chairman), Nicholas Tarrant, Caroline Spillane, Ian Talbot, Michael Nolan.
Registered office: Three Gateway, East Wall Road, Dublin 3, D03 R583, Ireland.
Registered in Ireland No. 465172

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 4: Terms & Definitions

| Term / Symbol | 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. |



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.

