



# Company Standard

## Conditions Governing the Connection and Operation of Export Limiting Schemes

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## Introduction

An Export Limiting Scheme (ELS) is being introduced 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 ELS standard shall be read 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.

### i. Scope

This document shall apply to inverter connected Mini-Generation installations, as defined in ESB Networks Standard ‘Conditions Governing the Connection and Operation of Mini-Generation’ ([DOC-030221-GAP](#)).

ELS does not apply to Micro-Generation schemes or standalone generator connections.

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	<a href="#">DTIS-230206-BRL</a>
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	<a href="#">DOC-030221-GAP</a>
Export Limitation Schemes for Mini-Generator installations Up to and including 72 A three phase (c. 50 kVA)	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	<a href="#">DTIS-250701-BDW</a>

## 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
<a href="#">DOC-030221-GAP</a>	Conditions Governing the Connection and Operation of Mini-Generation
<a href="#">DOC-230206-BRL</a>	Conditions Governing the Connection and Operation of Micro-Generation
<a href="#">DTIS-250701-BDW</a>	Connections Governing Connection to the Distribution System at Medium Voltage
<a href="#">DOC-060416-EEY</a>	Distribution Code
<a href="#">I.S. EN 50549-1</a>	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
<a href="#">I.S.EN ISO/IEC 17065</a>	Conformity Assessment – Requirements for bodies certifying products, processes and services
<a href="#">DOC-030303-AEN</a>	ESB Networks National Code of Practice for Customer Interface
<a href="#">I.S. 10101</a>	National Rules for Electrical Installations

# 1. Description of an Export Limiting Scheme (ELS)

## 1.1 Concept

For Mini-Generation connections, in the event of any non-planned outage of either the generation or demand, the resulting net customer demand/generation is felt on the DSO network. If this net customer combination of demand/generation is in excess of the MEC/ELS, this could cause voltage standards and/or thermal limits to be breached. An ELS is being introduced by ESB Networks to facilitate the installation of inverter-connected generation in excess of the available MEC for Mini-Generation connections only.

For the avoidance of doubt, in any generator connection where the existing/proposed MEC is zero, the connection shall be assessed under this document; Conditions Governing the Connection and Operation of Export Limiting Schemes (DOC-250221-GBT). In such 'MEC=0' cases the ELS shall assess the allowable level of generator inverter capacity which can be acceptably installed on the network and which is also within the MIC of the customer.

An ELS prevents the MEC being materially exceeded. It does this by ensuring that the Customer generation and load are matched in such a manner that:

- the customer's MEC is only ever temporarily exceeded for short periods (<5 seconds)
- by an amount that is no more than 5% of the customer's MEC
- the customer's MEC is still within the ultimate limit of Installed capacity, which is deemed to be the lesser of the MIC or 50 kVA (Mini-Generation)
- Harmonic Standards are not breached by the installation of the extra ELS generation

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

Ultimately, an ELS allows the installed capacity of a Mini-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 inverter capacity of the generation.

## 1.2 Execution

A Mini-Generation customer's MEC shall never be greater than their MIC [as per [DOC-030221-GAP](#)], and the installed Inverter Capacity of the generation connected shall not exceed the ELS agreed with ESB Networks. This also requires that the ELS is not greater than the MIC. ELS Schemes shall only apply to Mini-Generation connections.

An ELS scheme is unsuitable for, and shall not apply to, any form of standalone generator site.

In Mini-Generation cases where no export to the DSO network is contracted or requested i.e. MEC=0 generation sites, then the application for an MEC shall involve an assessment using the Mini-Generation and ELS, i.e. MEC=0 is a particular case of the application of an ELS scheme

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.

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

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

In all cases of MEC=0, an Export Limiting Relay is required 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

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

For ELS on Mini-Generation, witness testing shall be undertaken by ESB Networks at their discretion, on an audit basis for quality purposes.

Confirmation that an ELS is required shall be stated in the Mini-Generation installation application form (Form **NC7**, available on [www.esbnetworks.ie](http://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 Mini-Generation 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 Mini-Generation sites, then, where applicable, a subsequent application for an MEC shall involve an assessment using the Mini-Generation and ELS standards.

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 behind the inverter) 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)

### 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 MEC<sup>1</sup> 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 permitted<sup>2</sup>.

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.

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<sup>1</sup> 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).

<sup>2</sup> 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 Mini-Generation connections (<50 kVA) a backup disconnection device is required if

- the ELS is not 'fail safe'<sup>3</sup> 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.

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, 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 A<sup>4</sup> (unbalance may arise in controlling loads)

#### 2.3.3 Voltage Capability

During the operation time of the ELS the full installed capacity could be exported for up to 5 seconds and cause a rise in voltage above 253 V, 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%.

#### 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-EEY](#)). In such cases the ELS shall be modified to bring such disturbances within acceptable limits.

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.

#### 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).

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<sup>3</sup> '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.

<sup>4</sup> c. 6 kVA

## 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-EEY](#)), 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 the ELS Scheme does not:

- Have a Manufacturer's Declaration (Manufacturer's ESB Networks ELS Product Declaration in [Annex D](#)), or
- If it is not 'fail safe, or
- If it is not capable of restricting output to MEC within 5 seconds,

then an Export Limiting Relay shall be installed which shall trip if the MEC is exceeded by 5% for 5 seconds, or, in the case of MEC=0, exceed absolute export values of 11kVA (three phase) or 6kVA (single phase))

## 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:

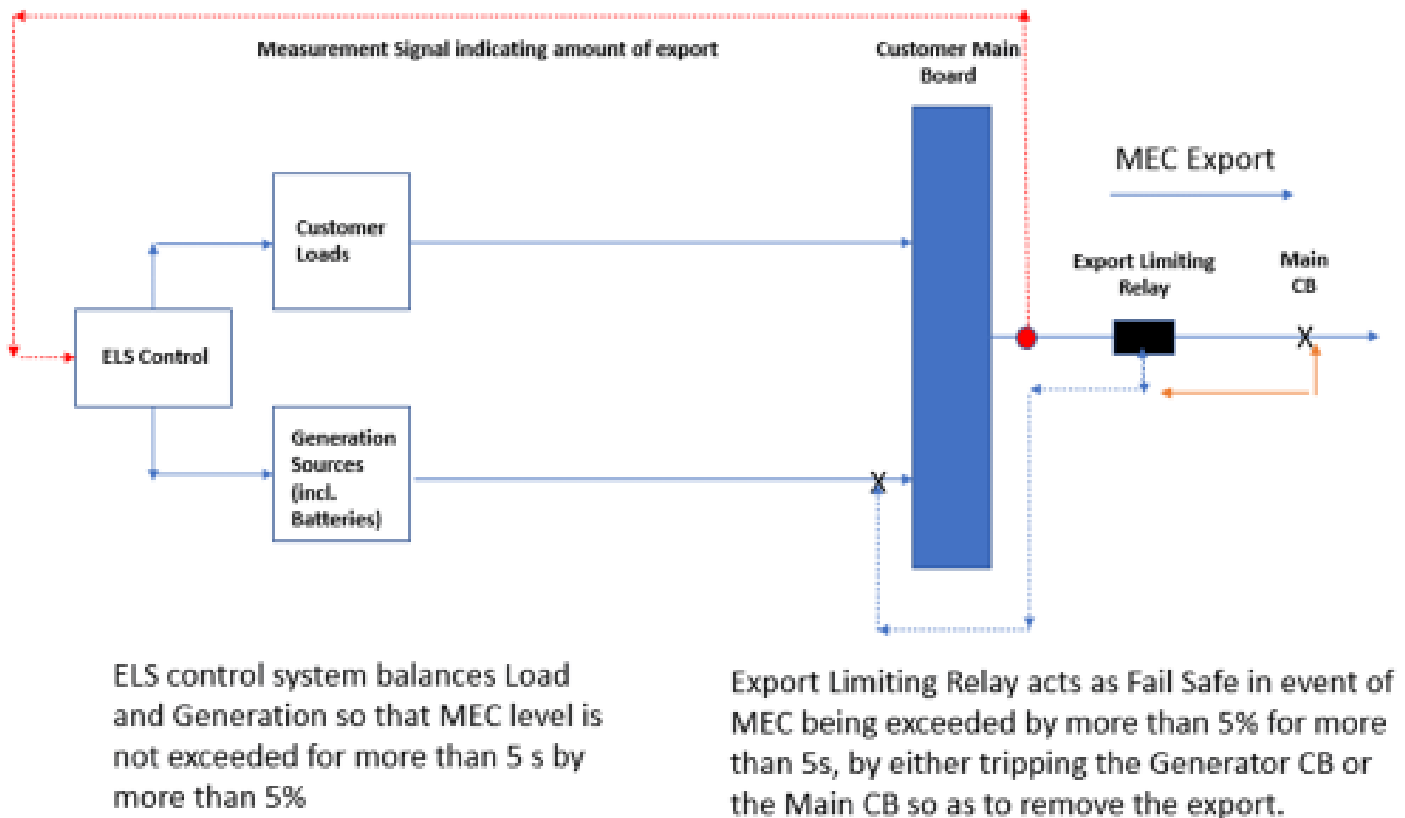
- the ELS Scheme is unable to prevent the MEC being exceeded by less than 5% for a period of more than 5 seconds,
- or is not 'fail safe'
- or a Manufacturer's ESB Networks ELS Product Declaration Form ([Annex D](#)) is not available
- or in the case of n MEC=0, the Export Limiting Relay shall operate to prevent export of more than 11 kVA (three phase) or 6 kVA (single phase) for more than 5 seconds

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 1: Diagram of ELS Schemes and Export Limiting Relay

### 3. Connection Offer Process for ELS for Mini-Generation

#### 3.1 Description

The ELS process shall require an application for connection to ESB Networks using the Mini-Generation installation application form (Form **NC7**, available on [www.esbnetworks.ie](http://www.esbnetworks.ie)). In this 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 Mini-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 'Conditions Governing the Connection and Operation of Mini-Generation' ([DOC-030221-GAP](#)) standard, and in compliance with the 'Conditions Governing the Connection and Operation of Export Limiting Schemes (DOC-250221-GBT) standard, or as otherwise agreed with ESB Networks, and;
- c) The above is certified by the production of:
  - i. A Test Form for Export Limitation 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](mailto:dsominigeneration@esb.ie)) to complete the connection on the DSO network.



**Until confirmation of the installation as above has been received by ESB Networks, the offered MEC contract (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. Applicable Technical Standards

All technical standards in the Conditions Governing the Connection and Operation of Mini-Generation ([DOC-030221-GAP](#)) shall 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.



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

The period of validity of the Connection Offers 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 Control Unit (CU)

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.

#### 5.2.2.5 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

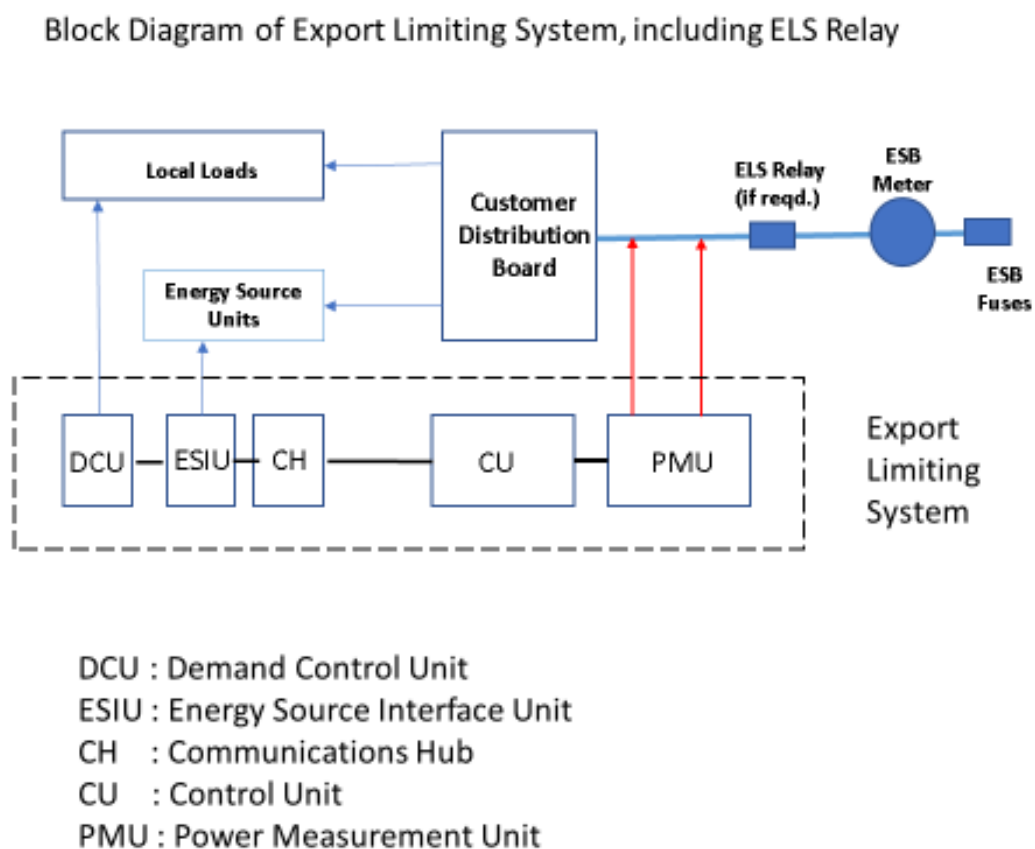


Figure 2: Block Diagram of ELS implementation



#### 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 ELS Function

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.

#### 5.2.7 Enabling the ELS

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

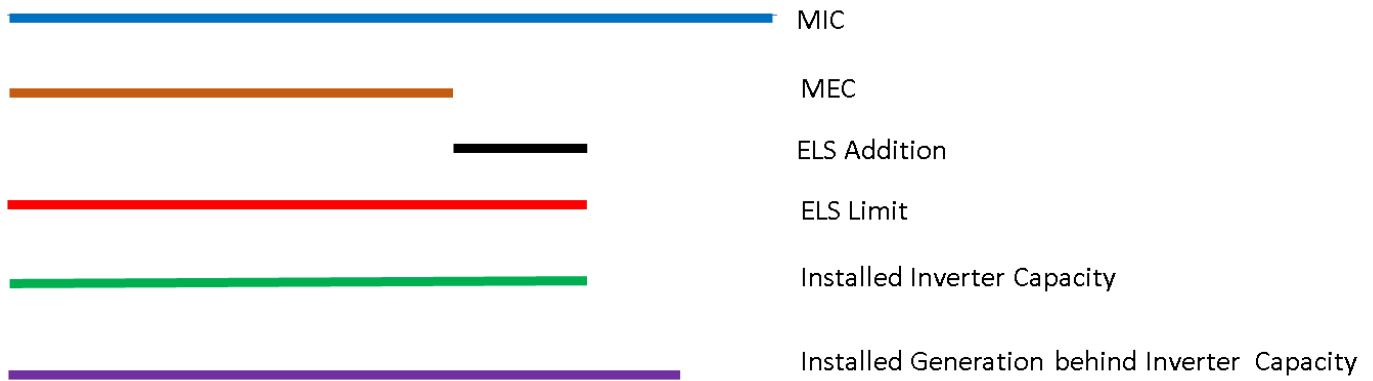
Following positive verification as per [Section 5.2.8](#), the Export Limiting Relay shall the be enabled



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](#).



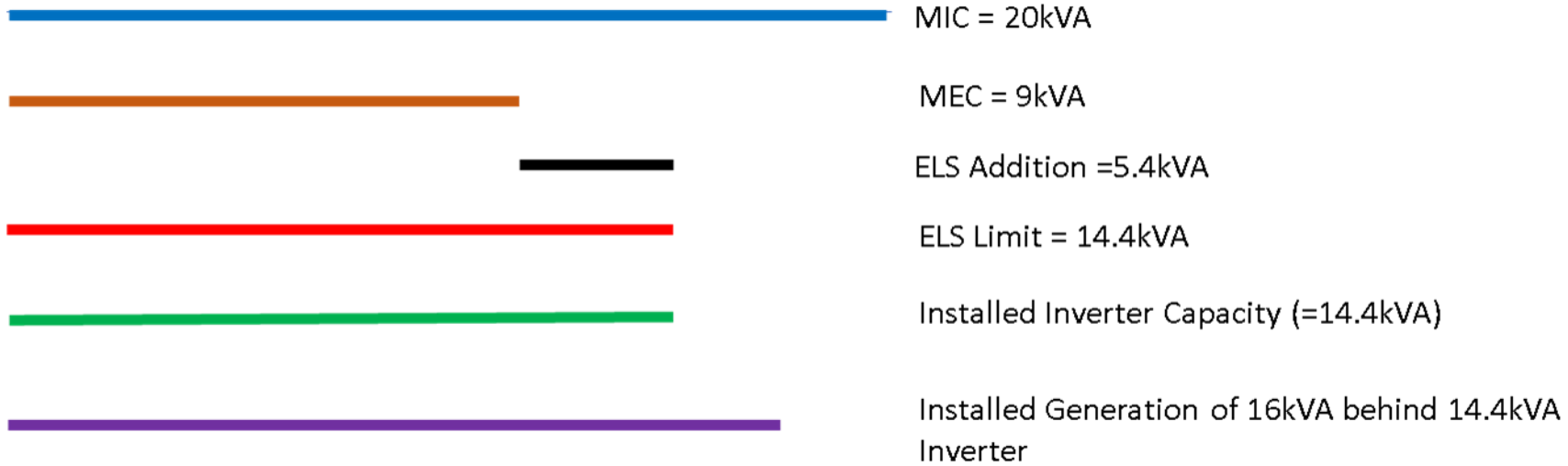
*Figure 3: Indicative illustration of an ELS scheme – the lengths of the lines are proportional to the kVA capacities.*

## Annex B. (Informative) Worked Example of an 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"> <li>The MEC sought (16 kVA) is less than the MIC (20 kVA)</li> <li>Assume there is adequate spare capacity upstream on the MV system and 38 kV system for any extra generation</li> </ul> <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"> <li>The available Thermal Capacity remaining on the 33 kVA transformer is 9 kVA (33 kVA – 24 kVA generation existing).</li> <li>The constraint imposed by the transformer's Thermal Capacity (rating) limits the MEC to no more than 9 kVA</li> </ul> <p>Voltage rise depends on:</p> <ul style="list-style-type: none"> <li>How far from the transformer the customer is</li> <li>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</li> <li>The total amount of generation flowing through the circuit and causing a voltage rise.</li> </ul> <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 <math>P_{sc}/R_{sc} = 360kVA / 33 = 10.9</math> kVA) based on the generation installed emitting the full allowable quantity of harmonic currents allowed within the <a href="#">I.S. EN 61000-3-12</a> 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 <a href="#">I.S. EN 61000-3-12</a> standard, and that an <math>R_{sc}</math> of 25 is stated. In such a case then, with a <math>P_{sc}</math> of 360kVA, a generator of up to 14.4 kVA (from <math>P_{sc}/R_{sc} = 360kVA / 25 = 14.4</math> 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>		
	<b>Constraint</b>	<b>Result</b>	<b>MEC Available (Lowest limit)</b>
	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	

	<p>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.</p>		
<p>Consideration of an ELS Scheme</p>	<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 (&lt;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>		
	<p><b>Constraint</b></p>	<p><b>Result</b></p>	
	<p>Voltage Rise limit</p>	<p>15 kVA</p>	
	<p>Harmonic limit</p>	<p>14.4 kVA</p>	
	<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 4: Indicative illustration of an ELS scheme for the worked example.*

## Annex C. (Mandatory) Form NC7-02-R1 - Test Form for Export Limitation Scheme

# Test Form for Export Limitation Scheme

## Form NC7-02-R1

(DOC-171121-HFQ)

### Test Form for Export Limitation Scheme 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' ([DOC-250221-GBT](#))

Please complete Parts 1, 2 and 3 below

#### Part 1: Customer and Installer Details

MPRN (Meter Point  
Registration Number):

Customer Name:  
(as registered to MPRN)

Address of ELS installation:

Eircode:

Installer (Safe Electric No):

Installer Name :

Installer Address:

Eircode:

Installer Mobile No:

Installer E-mail:



Part 2: Information to be provided	
Please indicate the appropriate answer below	
Descriptions:	Data:
Single Line Diagram of ELS control unit and associated load and generator connections.	Yes/ No
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/No
Maximum Export Capacity (MEC) agreed with ESB Networks (as set out in the Connection Agreement):	____ kVA
Export Limitation 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? <b>or</b> If Manufacturer’s ELS Product Declaration is unavailable, confirm that ELS Relay has been installed	Yes/No  Yes/No
Confirm that ELS Communication Links are metallic or fibre (as per Section 2.3 of <a href="#">DOC-250221-GBT</a> ), 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. <b>or</b> If ELS Communication Links are not metallic or fibre, confirm that an Export Limiting Relay (ELR) has been installed	Yes/No  Yes/No
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 <a href="#">DOC-250221-GBT</a>	Yes/No
Confirm that the ELS operates to limit the exported power to not exceed the MEC by more than 5% within 5 seconds	Yes/No
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. <b>or</b> If MEC=0, confirm that any exported power will not exceed 6kVA (single phase) or 11kVA (three phase) for more than 5 seconds.	Yes/No  Yes/No
<u>Relay Type, Manufacturer &amp; Model</u>	
Relay Type:	
Manufacturer:	
Model:	
Confirm that, following commissioning, settings have been restored to normal, that they are fixed, and that they cannot be readily altered by the customer.	Yes/No

Confirm that a description of the scheme, including a line diagram and settings are displayed on site.	Yes/No
--	--------



**If any answers are 'No' then the unit has failed the commissioning tests and shall not be put into service, as per Section 5.2 of ESB Networks Standard 'Conditions Governing the Connection and Operation of Export Limiting Schemes' ([DOC-250221-GBT](#))**

**Part 3: Test Confirmation**  
*To be completed by Installer*

I confirm that the ELS/ELR and the installation at the MPRN (as outlined in Part 1) comply with ESB Networks Standard 'Conditions Governing the Connection and Operation of Export Limiting Schemes' ([DOC-250221-GBT](#)) and the associated commissioning checks required.

Installer Signature:	Date:
Installer Company Name:	Position:

**Part 4: ESB Networks Witness Test (where applicable)**  
*To be completed by ESB Networks personnel in cases where testing has been witnessed*

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:
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This form shall be returned to ESB Networks ([dsominigeneration@esb.ie](mailto:dsominigeneration@esb.ie)) on completion of the tests.

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

# Manufacturer's ELS Product Declaration for ESB Networks

Form NC7-03-R1

(DOC-171121-HFP)

## Manufacturer's ELS Product Declaration for 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' ([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 ([I.S. EN 61000-3-2](#) and/or [I.S. 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 [I.S. EN 50549-1](#).

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.

Yes / No

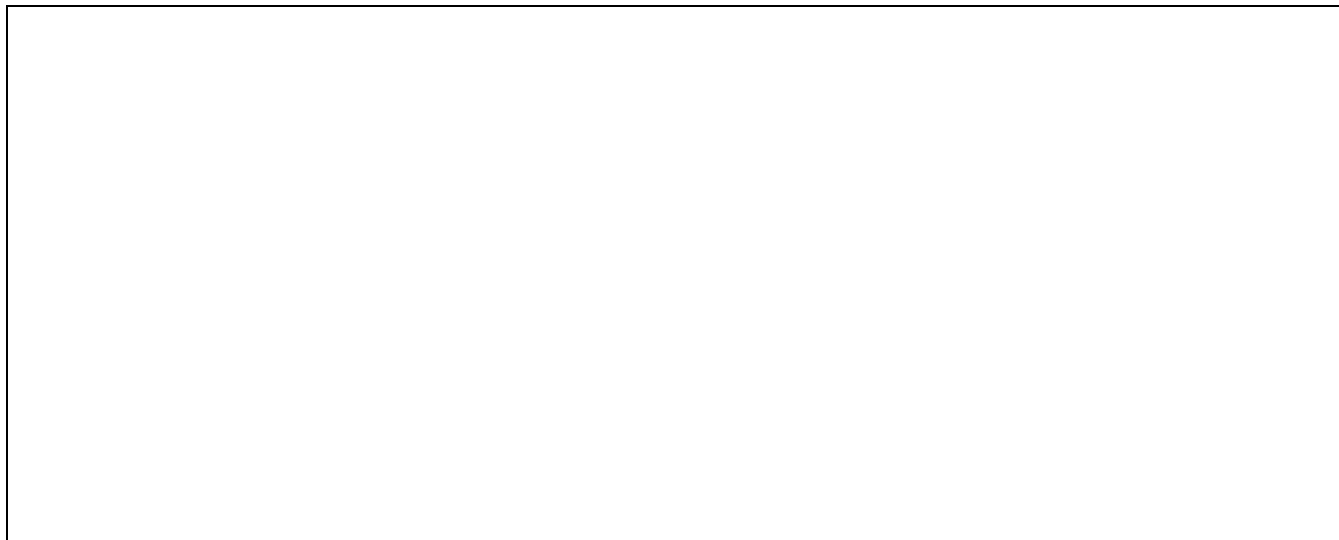
**Part 4: System Schematic**

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 :



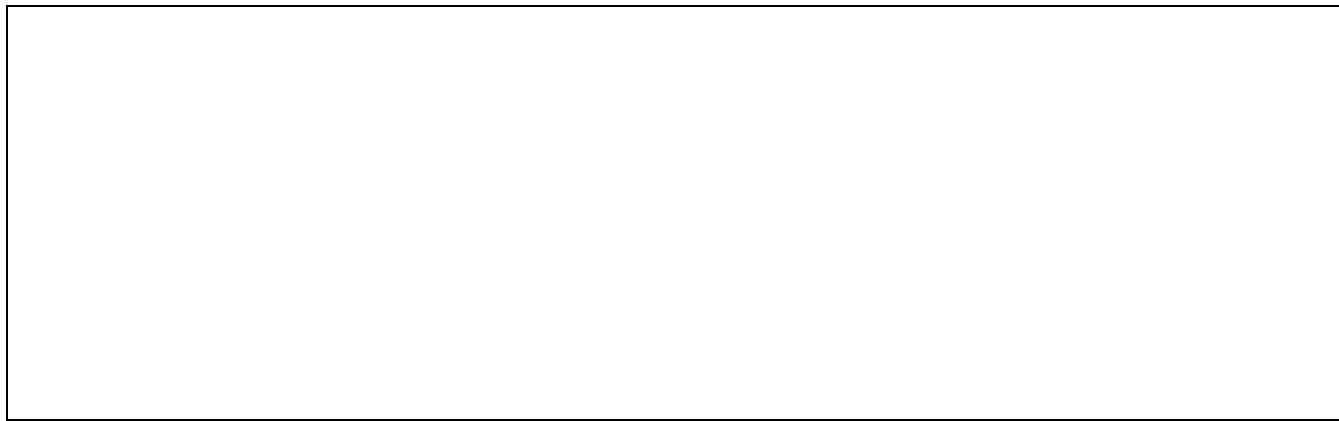
**Part 5: Component Interconnection/Failsafe Operation**

**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/No	Yes/No
2	Remove Power Supply to CU		Yes/No	Yes/No
3	Remove Power Supply to all Energy Source Units		Yes/No	Yes/No
4	Remove power Supply to all DCUs		Yes/No	Yes/No
5	Remove Power Supply to all Communication Hub Switches		Yes/No	Yes/No
6	Unplug PMU- CU Communications Cable		Yes/No	Yes/No
7	Unplug CU – ESIU Communications Cable (at ESIU end)		Yes/No	Yes/No
8	Unplug all ESIU –Communication Cables in turn		Yes/No	Yes/No
9	Unplug CU – DCU Comms. Cable for each DCU unit (at DCU end)		Yes/No	Yes/No
10	Unplug DCU – Load Comms cable		Yes/No	Yes/No

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*

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 / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
	Step change A 95% to 110%	Export = 105% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
	Step change A 95% to 120%	Export = 105% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
2	Step change B 95% to 105%	Export = 110% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
	Step change B 95% to 110%	Export = 110% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
	Step change B 95% to 120%	Export = 110% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
3	Step change C 95% to 105%	Export = 120% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
	Step change C 95% to 110%	Export = 120% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail
	Step change C 95% to 120%	Export = 120% of programmed export limit value	At 95% Voltage	Pass / Fail
			At 100% Voltage	Pass / Fail
			At 110% Voltage	Pass / Fail

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 of 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 removed for the test shall be checked and verified as correct.



<b>Part 6A: Confirmation of operation of ELS to limit export as required</b>	
<p><b>ESB Networks ELS requirements:</b> The ELS product(as outlined in Part 1) shall detect an excursion and reduce the export to the MEC or less, within 5 seconds.</p> <p>Under normal operating conditions, the ELS product (as outlined in Part 1) response time is less than 5 seconds.</p> <p>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.</p>	
Operation of above is confirmed	Yes / No
Operating Manual is available	Yes / No
The settings applied to ELS product(as outlined in Part 1) have taken account of the published ( <a href="#">DOC-250221-GBT</a> ) tolerances to ensure the required export limits and voltage limits shall be maintained.	Yes / No

<b>Part 7: Password Protection</b>	
<p><b>ESB Networks ELS requirement:</b> 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.</p>	Yes / No
All settings of the ELS product(as outlined in Part 1) are password protected and cannot be altered by the customer.	Yes/No

**Part 8: Installation Requirements**

**ELB 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:

## 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.

