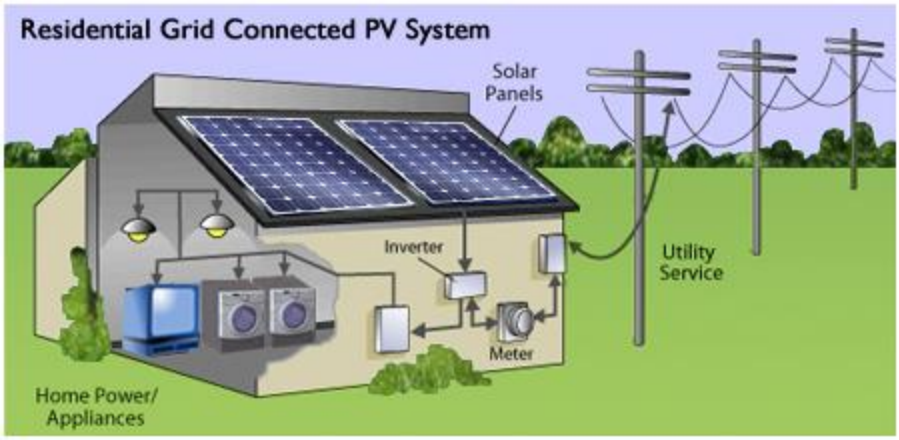
Grid Code

for

Small Scale Distributed Generation

(SSDG)

Version 2. 3 - September 2019



Central Electricity Board

Foreword

The purpose of this document is to assist the public to better understand the procedure for application, the requirements of the SSDG Grid Code and other related issues regarding the Small Scale Distributed Generation (SSDG) Project.

Any prospective applicant willing to take advantage of the Small Scale Distributed Generation (SSDG) Scheme is informed that:

I. Compliance to this Grid Code is mandatory

II. The provisions of the Electricity Act shall be adhered to.

III. This Grid Code will be reviewed and updated when the need arises.

Disclaimer

The Central Electricity Board's (CEB) "Grid Code for Small Scale Distributed Generator (SSDG)" (less than 50 kW), including any periodic revisions, published on the CEB website, constitute the minimum technical requirements for the connection of an SSDG of size less than 50 kW to CEB's low voltage distribution network. The owner of the SSDG may be required to meet additional requirements to ensure that the interconnection meets all local regulations and is safe for use. The requirements set in this Grid Code are based on system conditions that may be subject to change. As such, these requirements shall only be used as a guide. The use of this Grid Code and the information it contains is at the user's sole risk. Neither CEB, nor any of its personnel, makes any warranties or representations of any kind in connection with this Grid Code, including its correctness, accuracy, completeness or adequacy for any specific purpose. CEB will not be responsible or liable for any damage or loss that may arise due to the use of the Grid Code, reliance on the information it contains or any decisions made based on the Grid Code. CEB reserves the right to revise this Grid Code at any time. Any person wishing to make use of this Grid Code is invited to contact CEB before proceeding.

The CEB reserves the right to modify such technical specifications and requirements of the SSDG system before or during implementation of the SSDG connection process, in order to adhere to the latest operational and safety aspects of the network. The SSDG installation shall abide with the latest SSDG Grid Code and standards at the time of implementation of the project.

Revision

Version	Date	Changes
Version 2. 3	September 2019	Minor revisions

TABLE OF CONTENTS

CHAPTER 1 - PURPOSE OF GRID CODE

The Grid Code describes the technical criteria and requirements for interconnection of Small Scale Distributed Generators (SSDG) with CEB's low voltage (230/400V) network systems.

The Grid Code caters for the production of electricity from the following renewable energy technologies:

1. Photovoltaic (PV)
2. Wind Turbine

The Grid Code addresses connection of electricity producers under the SSDG Schemes. More details on the schemes are available on CEB website http://ceb.mu.

CHAPTER 2 –CONNECTING SMALL SCALE DISTRIBUTED GENERATORS (SSDG) TO THE CEB GRID

1.0 Connection Process

1 The duly filled SSDG Application Form, available at CEB Customer Service Office or downloaded from CEB website http://ceb.mu, along with all requested documents and Processing Fee (see Annex 3), shall be deposited at the nearest CEB Customer Service Office.

2 CEB analyses the Application Form and performs Tests on its grid.

3 The applicant is issued a Letter of Intent for installing the SSDG as per the Terms and Conditions that will be laid down in a *Connection Agreement, to* be signed between the applicant and the CEB.

4 Upon receipt of the Letter of Intent, applicant pays the Connection Fees (Annex 3) and submits his Implementation Schedule to the CEB within three weeks.

Applicant shall also submit Proof of Firm Order placed with supplier/manufacturer and Technical Details of the SSDG equipment within three months of issue of the Letter of Intent otherwise his application shall be cancelled without any prior notice from the CEB.

5 Applicant signs a Connection Agreement upon submission of Proof of Order and Technical Details of the SSDG equipment to the CEB.

6 The installation shall be completed within a period of six months from the date of Letter of Intent, otherwise the offer shall lapse automatically.

7 Upon completion of installation, Applicant/Installer submits to the CEB a duly signed "Certificate of Installation" as per Annex 5.

8 CEB then installs the Import/Export Meter, Production Meter, Safety Items etc. and prepares an Inspection Checklist for internal use

9 CEB shall test the installation for its compliance with the requirements of the Grid Code and commission same.

Commercial operation of SSDG starts if Testing & Commissioning is successful.

2.0 Capacity Allocation

Capacity allocation in the feeders and transformers shall be done according to the following rules:

(1) Applications shall be processed strictly according to the submission date and time – "First in, First Out".

(2) Applications shall be allocated to the relevant feeder and distribution transformer where the applicant is connected.
During analysis stage, if the maximum allowed capacity is found to have been already attained for the feeder or transformer, the applications will not be entertained unless the applicant opts for a network review.

(3) Allocated capacity shall remain valid for a period of six months, following issue of Letter of Intent, where the applicant shall develop the project subject to Part (4) and (5) below.

(4) The applicant shall submit proof of firm order placed with supplier/ manufacturer within three months of issue of Letter of Intent. Failing to submit same shall entail the cancellation of the application and the capacity shall be freed for other applicants.

(5) Failing to complete the installation within the six months period, following issue of Letter of Intent, shall entail the automatic cancellation of the offer and the capacity shall be freed for other applicants.

All SSDGs of capacity **less than 5kW** shall have **either single phase or three phase output**.

All SSDGs of capacity **5kW** and above shall have **three phase output only**.

Additionally, subject to the requirements of the prevailing scheme, the SSDG capacity shall also be limited to the technically permissible SSDG connection capacity of the distribution transformer feeding the customer. Should there be other SSDGs connected on the same distribution transformer; the total capacity of all these shall be taken into consideration for the acceptance of an SSDG application.

CHAPTER 3 - GRID CODE REQUIREMENTS AND SAFETY ASPECTS

1.0 Design Parameters

The SSDG shall be connected to the 230/400 V system and operated within the parameters as listed in Table 1 below. The SSDG has to be functioning and protect itself within the range of the voltages, currents and frequencies existing in the CEB's grid.

Description	Range
Voltage	230/400 V ± 6 %
Short Circuit Characteristics	(1 sec) 18 kA, (50 Hz)
Nominal Frequency	50 Hz
Statutory Frequency Deviation	50 Hz ±1.5 %
Operating Frequency Range	47 Hz – 52 Hz

Table 1: *Normal operating parameters of the CEB's Low Voltage grid*

The CEB LV grid is designed as a TT system.
The above values are mandatory for all SSDGs. Same values and provisions apply in the case that the SSDG has a battery set.

2.0 Protection Requirements

The coordination and selectivity of the protection system must be safeguarded even with the entrance of new generation into the system. To guarantee this requirement, the protections to be installed are listed in the following chapters and the settings of those protections shall conform at minimum to the requirements of the Grid Code.

In case of short circuits in the generator's side, the SSDG shall adjust its protections in such a way that will avoid unnecessary trips and at the same time avoiding that the incident propagates to the CEB LV network.

In case of incidents originated external to generator's system, like short circuits in the distribution system, fluctuations of frequency or voltage, Generators will give priority to the network protections to clear the incidence and act accordingly with the coordination and selectivity principles of the protections system.

2.1 Availability of Protection

The applicant shall ensure that all equipment are protected and that all elements of the protection, including associated inter-tripping, are operational at all times. Failure of the protection will require the SSDG plant to be taken out of service.

The SSDG shall be protected against:

(1) Overload.
(2) Short circuit within the SSDG.
(3) Earth faults in the LV grid close vicinity of the SSDG.
(4) Over Current.
(5) Abnormal Voltages (Table 2)
(6) Abnormal Frequencies (Table 2)
(7) Lightning.
(8) Loss of Mains.

2.2 DC Functions of protection apparatus

All protection apparatus functions shall operate down to a level of 50% of the nominal DC supply voltage of the DC system, or the system must be able to safely disconnect and shutdown when operation conditions are outside the nominal operating DC voltage specified in the DC system specifications.

2.3 Protection Flagging, Indication and Alarms

All protective devices supplied to satisfy the CEB's requirements shall be equipped with operation indicators. Such indicators shall be sufficient to enable the identification of which devices caused a particular trip.

Any failure of the applicant's tripping supplies, protection apparatus and circuit breaker trip coils shall be supervised within the applicant's installation, and the applicant shall be responsible for prompt action to be taken to remedy such failure.

2.4 Trip Settings

The basic trip settings must comply with the values stated in Table 2.

Parameter	Symbol	Trip Setting	Clearance Time
Over Voltage ([a])	U>>	230 V + 10 %	0.2 s
Over Voltage	U>	230 V + 6 %	1.5 s
Under Voltage	U<	230 V – 6 %	1.5 s
Over Frequency ([b])	f>	50 Hz + 2 %	0.5 s
Under Frequency	f<	50 Hz - 6 %	0.5 s
Loss of Mains	df/dt Vector shift	2.5 Hz / s 10 degrees	0.5 s

Table 2: *Default interface protection settings.*

NOTE: Voltage and frequency is referenced to the Supply Terminals.

([a]) If the SSDG can generate higher voltage than the trip setting, the step 2 over voltage is required.

([b]) The trip setting for over frequency is set lower than the maximum operating frequency defined in Table 1 in order to avoid contribution of the SSDG to rising frequency.

2.5 Network Islanding

The applicant shall not supply power to the CEB's network during any outages of the system. The SSDG may only be operated during such outages to supply the applicant's own load (isolated generation) with a visibly open tie to the CEB's network. The SSDG shall be disconnected from the CEB's network within 0.5 seconds of the formation of an island as shown in Table 2.

2.6 Re-connection

Following a protection initiated disconnection, the SSDG is to remain disconnected from the network until the voltage and frequency at the supply terminals has remained within the nominal limits for at least 3 minutes. Automatic reconnection is only allowed when disconnection was due to operating parameters being outside the normal operating range stated in Table 1, not if disconnection was caused by malfunctioning of any devices within the SSDG installation.

2.7 Synchronizing AC generators

The SSDG shall provide and install automatic synchronizing features. Check Synchronizing shall be provided on all generator circuit breakers and any other circuit breakers, unless equipped with appropriate interlocked, that are capable of connecting the SSDG plant to the CEB's network. Check Synchronizing Interlocks shall include a feature such that circuit breaker closure via the Check Synchronizing Interlock is not possible if the permissive closing contact is closed prior to the circuit breaker close signal being generated by close command being activated.

2.8 Earthing Requirements

Earthing shall be according to IEC 60364-5-55.

For systems capable of operating in isolated generation protection by automatic disconnection of supply shall not rely upon the connection to the earthed point of the utility supply system.

When a SSDG is operating in parallel with the CEB's network, there shall be no direct connection between the cogenerator winding (or pole of the primary energy source in the case of a PV array or Fuel Cells) and the CEB's earth terminal.

The winding of an a.c. generator must not be earthed. Note that a d.c. source or d.c. generator could be earthed provided the inverter separates the a.c. and d.c. sides by at least the equivalent of a safety isolating transformer. However, consideration would then need to be given to the avoidance of corrosion on the d.c. side.

At the CEB's grid TT earthing system is normal. The neutral and earth conductors must be kept separate throughout the installation, with the final earth terminal connected to a local earth electrode.

Warning Notice that: ***"CONDUCTORS MAY REMAIN LIVE WHEN ISOLATOR IS OPEN"*** shall be conspicuously displayed at the installation.

3.0 Power Quality

3.1 Limitation of DC Injection

The SSDG should not inject a DC current greater than the largest value of 20 mA and 0.25 % of the rated AC output current per phase.

3.2 Limitation of Voltage Flicker induced by the SSDG

The SSDG installation shall not cause abnormal flicker beyond the limits defined by the "Maximum Borderline of Irritation Curve" specified in the IEEE 519-1992.

3.3 Harmonics

Based on IEEE 519, the Total Harmonic Distortion (THD) Voltage shall not exceed 5.0% of the fundamental on 400 V when measured at the point of common coupling (PCC).

The total harmonic distortion will depend on the injected harmonic current and the system impedance seen from the PCC. However, in order to facilitate the fulfilment of the requirements by e.g. inverter manufacturers, the voltage distortion limits have been translated into a similar requirement on current distortion.

The SSDG system output should have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system. The SSDG system electrical output at the PCC should comply with Clause 10 of IEEE Std. 519-1992 and should be used to define the acceptable distortion levels for PV systems connected to a utility. The key requirements of this clause are summarized in the following:

(a) Total Harmonic Current Distortion (Total Demand Distortion, TDD) shall be less than 5% of the fundamental frequency current at rated current output.

(b) Each individual harmonic shall be limited to the percentages listed in Table 3 . The limits in Table 3 are a percentage of the fundamental frequency current at rated current output.

(c) Even harmonics in these ranges shall be <25% of the odd harmonic limits listed.

Odd Harmonics	Maximum Harmonic Current Distortion
3^{rd} -9^{th}	4.0%
11^{th} -15^{th}	2.0%
17^{th} -21^{st}	1.5%
23^{rd} -33^{rd}	0.6%
Above the 33^{rd}	0.3%

Table 3: *Distortion Limits as recommended in IEEE Std. 519-1992 for six-pulse converters*

3.4 Surge Withstand Capability

The interconnection system shall have a surge withstand capability, both oscillatory and fast transient, in accordance with IEC 62305-3, the test levels of 1.5 kV. The design of control systems shall meet or exceed the surge withstand capability requirements of IEEE C37.90.

3.5 Voltage and Current Unbalance

The connection of unbalanced loads and generation to the distribution network can result in unbalanced currents and voltages. Generators that use 3-phase generators or inverters which inject balanced currents into the distribution network do not increase levels of voltage imbalance in the network. In fact, embedded generators which use 3-phase induction generators can actually reduce voltage imbalance.

The total voltage unbalance in the grid should be smaller than 2%, where the unbalance, $U_{unbalance}$, is defined as the maximum deviation from the average of the three-phase voltages, U_a, U_b and U_c, divided by average of the three-phase voltages.

$$U_{unbalance} = \frac{Max\ (U_a, U_b, U_c) - U_{avg}(a,b,c)}{U_{avg}(a,b,c)} \cdot 100\%$$

The contribution from one installation may not cause an increase of the voltage unbalance of more than 1.3%.

When considering three phase units, the contribution to the voltage unbalance can be described as

$$U_{unbalance} = \frac{\sqrt{3} \cdot I_{neg\ seq\ load} \cdot U_{line}}{S_{sc}}$$

Or

$$I_{neg\ seq\ load} = \frac{\sqrt{3} \cdot U_{unbalance}(\%) \cdot U_{line}}{S_{sc}}$$

Where

- S_{SC} is the Three phase short circuit power
- $I_{neg\ seq\ load}$ is Negative sequence of component loads
- U_{line} is the line voltage
- $U_{unbalance}$ the voltage unbalance

If nothing else is stated the S_{SC} shall be 2.5 MVA. The demand on voltage unbalance on a three phase load can be translated into a demand on the maximum negative sequence current.

$$I_{\max\ \ neg\ seq\ load} = \frac{\sqrt{3} \cdot 1.3\% \cdot 400}{2.5} = 3.6\ A$$

3.6 Voltage Step Change

The process of starting an SSDG can sometimes cause step changes in voltage levels in the distribution network. These step changes are caused by inrush currents, which may occur when transformers or induction generators are energised from the network. Synchronous generators do not give rise to inrush currents themselves, but their generator transformers may do so if they are energised from the network. Step voltage changes will also occur whenever a loaded generator is suddenly disconnected from the network due to faults or other occurrences.

Step voltage changes caused by the connection and disconnection of generating plants at the distribution level, should not exceed ±3% for infrequent planned switching events or outages and ±6% for unplanned outages such as faults.

If the connection of the SSDG to the grid does not exceed the following values in Table 4 it is expected to stay within the above mentioned voltage levels.

Connection	Inrush current
Single phase	19 A
Three phase	30 A

Table 4: *Maximum inrush current*

Where induction generators are used, as in fixed speed wind turbines, they shall be fitted with soft starters'. These devices limit inrush currents to roughly the same level as the normal rated current. This reduces the magnitude of the step voltage changes which occur on starting.

4.0 Power Factor

The power factor of the SSDG at normal operating conditions across the statutory range of nominal voltage shall be between 0.95 leading and 0.95 lagging.

5.0 Network Maintenance

The Preventive and Corrective maintenance of the feeder where the SSDG is connected may interrupt the SSDG's generation. No compensation shall be applicable for the loss of generation. CEB will communicate their maintenance plans following the same media as for the rest of the network customers.

6.0 Safety, Isolation and Switching

6.1 Rules for working on Low Voltage (LV) grid

According to the CEB Safety Rules based on Occupational Safety and Health Act 2005, the following rules, amongst others, must be respected before working on a LV grid:

a. The system must be Isolated from all possible sources of supply, all switches must be locked in **visibly** open positions, the system must be tested on the site of work, and the system must be short-circuited and Earthed.

b. The SSDG shall have a local means of isolation that disconnects all live conductors including the neutral. The producer shall not energize a de-energized CEB's Power circuit.

c. Switches shall be installed to disable the automatic or manual closing of the interconnecting switch or breaker. This switch shall be accessible to the CEB's personnel to obtain the necessary safety requirements when the CEB's personnel is working on associated equipment or lines. While the CEB's personnel is working on the grid, the operation of switches shall be restricted to the CEB only. This can be assured by keeping the keys of lockable switches in safe custody. Alternatively the CEB's personnel will remove and keep fuses while working on lines.

d. In all circumstances the switch, which must be manual, must be capable of being secured in the "OFF" isolating position. The switch must be located at an easily accessible position in the producer's installation.

e. Isolation for an SSDG shall be as per Figure 1:

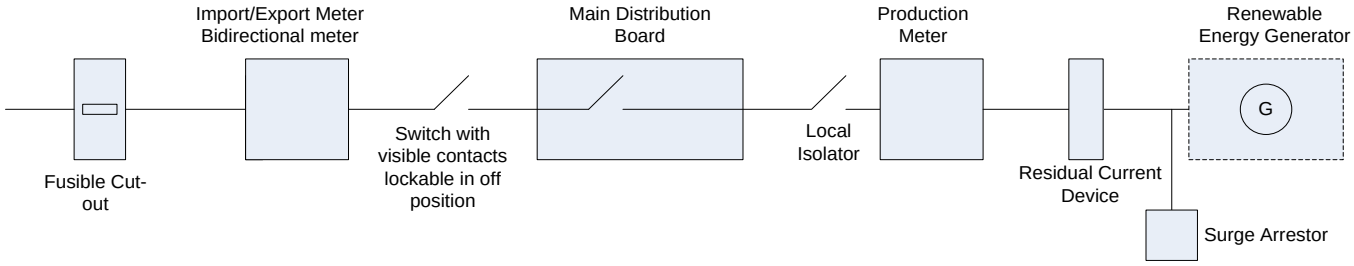


Figure 1: *Example on means of Isolation for an SSDG*

f. The visible switch shall be visibly marked. Also all transformers that carry SSDG installations on the LV side shall be visibly marked. Additionally the CEB will maintain an updated register of all SSDGs with precise addresses, connecting points and relevant transformers.

6.2 Safety Concerns

The SSDG owner shall observe the following safety concerns:

(a) Persons must be warned that the installation includes a SSDG so that safety precautions should be taken to avoid the risk of electric shock/electrocution. Both the mains supply and the micro-generator must be securely isolated before electrical work is performed on any part of the installation. Adequate labelling must be placed to warn that the installation is connected to another source of energy.

(b) Photovoltaic (PV) cells will produce an output whenever they are exposed to light, and wind turbines are likely to produce an output whenever they are turning. Additional precautions such as covering the PV cells or restraining the turbine from turning will be necessary when working on those parts of the circuit close to the source of energy and upstream of the means of isolation.

To guarantee this isolation, the generator operator shall follow the supplier instructions or propose any other means to guarantee it.

(c) The manufacturer or supplier of the SSDG is required to certify compliance with the Electrical Equipment Safety Regulations and the Electromagnetic Compatibility Regulations. The SSDG will be CE marked or tested by equivalent accredited testing agencies to confirm this. This should ensure that the SSDG is satisfactory in a domestic installation in terms of the power factor, generation of harmonics and voltage disturbances arising from starting current and synchronization.

6.3 Electromagnetic Emission / Immunity

The SSDG shall comply with the requirements of the EMC Directive and in particular the product family emission standards.

6.4 Labels

To indicate the presence of the SSDG within the premises, a label as per Figure 2 will be fixed by the CEB at:

(a) the supply terminals (fused cut-out)

(b) the meter position

(c) the consumer unit, and

(d) all the points of isolation

Figure 2: *SSDG Label*

The installation operating instructions must contain the manufacturer's contact details e.g. name, telephone number and web address.

6.5 Documentation

Up-to-date information must be displayed at the SSDG as follows:

(a) A single line diagram showing the configuration between the SSDG and the CEB's fused cut-out. This diagram is also required to show by whom the generator is owned and maintained.

(b) A summary of the protection's separate settings incorporated within the equipment.

The figure 3 below is an example of the type of single line diagram that needs to be displayed.

This diagram is for illustrative purposes and not intended to be fully descriptive.

A fully descriptive electrical schematic diagram shall be framed and properly fixed on a wall, within the SSDG setup, visible to CEB officers.

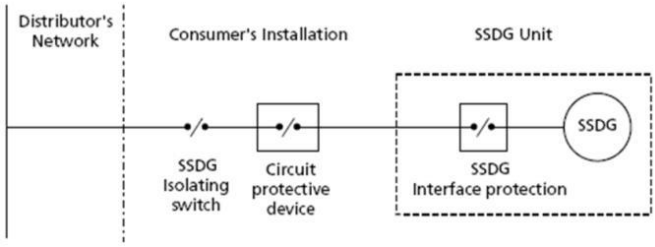


Figure 3: Example of circuit diagram for a SSDG installation

(c) In addition the maintenance requirements and maintenance services available shall be documented.

(d) The applicant shall keep a certificate signed by the maintenance contractor containing at least the following:

- A statement confirming that the solar PV system/Wind meets the requirements of this standard.
- Client's name and address.
- Site address (if different).
- Contractors name, address etc.
- List of key components installed.
- Estimation of system performance

6.6 Information Plate

The following information shall appear on the information plate:

(a) Manufacturer's Name or trade mark;

(b) Type designation or identification number, or any other means of identification making it possible to obtain relevant information from the manufacturer;

(c) Rated Power;

(d) Nominal Voltage;

(e) Nominal Frequency;

(f) Phases;

(g) Power Factor.

6.7 Electrical Contractor / Installer

The SSDG shall be installed in accordance with the instructions issued by the manufacturer.

In designing a connection for an SSDG, the electrical contractor /installer must consider all the issues that would need to be covered for a conventional final circuit, including:

(1) the maximum demand (and the generator output);
(2) the type of earthing arrangement;
(3) the nature of the supply;
(4) external influences;
(5) compatibility, maintainability and accessibility;
(6) protection against electric shock;
(7) protection against thermal effects;
(8) protection against overcurrent;
(9) isolation and switching;
(10) selection and installation issues.

The installer must affix a label clearly indicating the next scheduled maintenance of the installations and inform the CEB, who will add the information to the SSDG-register.

The installer must be skilled in the field of SSDG installations and possess a relevant and approved certificate.

7.0 Metering

In order to calculate the export or import of the applicant, a bidirectional meter (*Import/Export Meter*) measuring both the imported and exported energy shall be installed.

A second meter (*Production Meter*) measuring the gross energy production of the SSDG shall be installed as shown in Figure 1 above.

The Import/Export Meter and the Production Meter shall be installed next to each other and be easily accessible to CEB personnel.

Greenfield installation shall not be entertained in this project.

8.0 Testing, Commissioning and Maintenance

Testing and commissioning of SSDGs will be done in the presence of the CEB. The applicant shall notify the CEB in advance with a testing and commissioning plan. The applicant shall keep written records of test results and protection settings. The applicant shall regularly maintain their protection systems in accordance with good electrical industry practice.

9.0 Standards and Regulations

All electrical apparatus, materials and wiring supplied shall comply with the Electricity Act, the Central Electricity Board Act, Electricity Regulations, this code and the following standards amongst others:

PV Modules	
IEC 61215	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval
IEC 61646	Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval
IEC 61730 - Part 1	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
IEC 61730– Part 2	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
IEC 61701	Salt mist corrosion testing of photovoltaic (PV) modules
IEC 628041	System voltage durability test for crystalline silicon modules – design qualification and type approval
PV INVERTERS	
IEC 62109-1	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
IEC 62109-2	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
IEC 62116	Test Procedure for islanding prevention measures for Utility connected photovoltaic inverters
IEC 61683	Photovoltaic Systems – Power conditioners – Procedure for measuring efficiency
GRID-CONNECTED PV SYSTEM	
IEC 61727	Photovoltaic (PV) systems - Characteristics of the utility interface
EN 50438	Requirements for the connection of micro-generators in parallel with public low voltage distribution networks

IEC 60364-7-712	Electrical installations of buildings - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems
IEC 62446	Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection
IEC 61724	Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis
IEC: 60904-1	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics
IEEE P1547	Series of Standards for Interconnection, May, 2003, NREL/CP-560-34003
GENERAL ENGINEERING STANDARDS	
IEC 60364-5-55	Electrical installations of buildings
IEC 60664-1	Insulation coordination for equipment within low-voltage systems –Part 1: Principles, requirements and tests
IEC 60909-1	Short circuit calculation in three-phase ac systems.
IEC 62305-3	Protection against lightning, part 3 physical damage and life hazards in structures
IEC 60364-1	Electrical installations of buildings - Part 1: Scope, object and fundamental principles
IEC 60364-5-54	Electrical installations of buildings. Part 5: Selection and erection of electrical equipment. Chapter 54: Earthing arrangements and protective conductors
IEEE C37.90	IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
Power Quality	
IEC 61000-3-2	Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)
IEC 61000-3-3	Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
IEC 61000-6-1	Generic standard -EMC - Susceptibility - Residential, Commercial and Light industry
IEC 61000-6-3	Generic standard - EMC - Emissions - Residential, Commercial and Light industry
IEEE 519	IEEE Recommended practice and requirements for harmonic control of electric power systems, Institute of Electrical and Electronic Engineers, Piscataway, NJ. April 1992

The applicant may be required to produce certificates conforming to the above standards for their SSDG installation upon CEB's request.

Note: All specifications shall be according to the latest edition of the standards mentioned above.
In addition the SSDG owner shall ensure that his proposed installations comply with all prevailing regulations pertaining to environment, health and safety, etc.

CHAPTER 4 - CONDITIONS ON NETWORK FOR REVIEW OF APPLICATION/ RECONSTRUCTION OF NETWORK

- The total capacity of installed distributed generators (SSDG) on the relevant 22kV/0.4 kV or 6.6kV/0.4kV transformer exceeds 25 % of the LV transformer fuse capacity.
- The total capacity of installed distributed generators (SSDG) on the relevant low voltage feeder exceeds 90 % of the feeder fuse capacity.
- The capacity of SSDG at one customer terminal exceeds the capacity of the fuse at the existing customer terminal.
- The capacity of SSDG at one installation exceeds 25 kW in certain areas.
- The addition of an SSDG on the LV network, exceeds the total technically permissible SSDG connection capacity of the 22/0.4 kV distribution transformer or the LV feeder.
- Reconstruction of the LV network shall be done if any irregularities are noted at the customer's premises.
- Applicant shall carry out necessary civil works (construction of cabins for housing meter, switch or laying of cables underground), as instructed by CEB, if required.

CHAPTER 5 - GRID CODE MODIFICATIONS

CEB will propose a new version of this Grid Code in case that:

(i) some of the values included in it needs to be modified due to the evolution of the system.

(ii) the amount of generation in one or more of the segments considered requires a more severe control.

(iii) a better adequacy to operation conditions is required.

CHAPTER 6 - NON COMPLIANCE WITH THE CODE

In case of non-compliance with any of the technical provisions in this Grid Code, CEB shall inform the owner in writing of the discrepancies. The SSDG owner shall have 30 days to rectify the discrepancies.

Failing to do that, CEB shall be entitled to disconnect the SSDG installation.

CEB shall be entitled to disconnect the SSDG without prior notification if the installation conditions are harmful or creates unavoidable risks for the safety.

CEB shall not be responsible for any damage if such disconnection requires the disconnection of other loads associated or connected to the same connection as the SSDG.

Reconnection of the SSDG shall require that CEB certifies that the installation complies with this Grid Code. Fees applicable shall be the same as for reconnection fee.

ANNEX 1: ABBREVIATIONS AND DEFINITIONS

"AC" means Alternating Current;

"Applicant" means a producer of electricity through a SSDG installation;

"CEB" means the Central Electricity Board;

" Circuit breaker " means a switching device capable of making, carrying, and breaking currents under normal circuit conditions and also making, carrying for a specified time, and breaking currents under specified abnormal conditions such as those of short circuit;

"DC" means Direct Current;

"Dedicated transformer" means a transformer installed between the CEB's network and SSDG network that serves only the SSDG and attached loads, if any;

"DG" means Distributed Generation;

"Distributed generation" means electric generation facilities connected to the Utility network at the PCC;

"Directional-power relay" means a relay that operates on a predetermined value of power flow in a given direction, or upon reverse power so that, when used with SSDG in a non-export configuration, it will prevent power flow into the CEB´s Network;

"Flicker" means a variation of input voltage sufficient in duration to allow visual observation of a change in electric light source intensity;

"Fault" means a physical condition that causes a device, a component, or an element to fail to perform in a required manner, for example a short-circuit, a broken wire, an intermittent connection;

"Frequency" means the number of complete cycles of sinusoidal variations per unit time;

"Greenfield" means an installation of SSDG at a location without existing connection point;

"Grid" means CEB's network that brings electricity from power stations to consumers;

"THD" means Total Harmonic Distortion;

"Harmonic distortion" means continuous distortion of the normal sine wave; typically caused by nonlinear loads or by inverters, measured in Total Harmonic Distortion (THD);

"IGBT" means Insulated-gate bipolar transistor;

"Installer" means a person who has been certified by the supplier or has followed a course on Certified SSDG installation;

"IPP" means an Independent Power Producer;

"Islanding" means a condition in which a portion of the CEB's network is energised by one or more SSDGs through their PCC(s) while electrically separated from the rest of the system;

"Isolated Generation" means a condition where the electrical path at the PCC is open and the SSDG continues to energise local loads;

"kV" means kilovolt;

"kVA" means Kilovolt Ampere

"kW" means Kilo Watt (1,000 W = 1,000 J/s); "kWh" means Kilowatt hour (1,000 watt hours);

"LV" means Low Voltage (Voltage below 1,000 V);

"MW" means megawatt (1,000,000 W = 1,000,000 J/s);

"Parallel operation" means a condition where the SSDG is operating while connected to CEB's network;

"PCC" means point of common coupling;

"Point of Common Coupling (PCC)" means the point at which a SSDG is connected to the CEB's network;

"Power factor Ratio" means ratio of real to total apparent power (kW/kVA) expressed as a decimal or percentage;

"Producer" means a producer of electricity through a SSDG installation or the owner thereof;

"PV" means photovoltaic;

"PWM" means Pulse width modulation;

"RE" means renewable energy;

"SSDG" means Small Scale Distributed Generation up to 50 kW as categorised in Schedule 2

"SWC" means Surge Withstand Capability, the immunity of this equipment to fast and repetitive electrical transients;

"TT system" means in a TT earthing system, the protective earth connection of the consumer is provided by a local connection to earth;

"Voltage-restrained over-current relay" means a protective relay in which the pickup and over-current tripping times are affected by the voltage.

ANNEX 2: FEED IN TARIFF (FIT)

Tariff, if applicable, will be determined according to the prevailing tariff scheme in force.

Refer to CEB website for more details.

ANNEX 3: CEB FEES

Fees for processing Application and Connection (Non Refundable)

Processing of Application

Connection for Single phase

Connection for Three phase

Change of Installer / Equipment/ Re-Evaluation of Application

Engineering Review / Distribution Study

Preparation of Estimate for Network Modification

Domestic

Others

Revision of estimate

Network Construction / Modification

The costs for network construction or modification will be determined after carrying out the engineering review.

The value of each of the above listed fees will be set by the CEB in specific by laws and published on the CEB website. Applicants are advised to consult the CEB website for the latest fees.

ANNEX 4: SSDG APPLICATION FORM

A copy of the Application Form can be downloaded from the CEB website.

ANNEX 5: CERTIFICATE OF INSTALLATION

After completing the SSDG installation, Applicant/Installer shall submit the following duly filled and signed "Certificate of Installation" to the CEB (available on the CEB website):

CERTIFICATE OF INSTALLATION

I hereby certify that the installation of the SSDG of Capacity [……...] kW, situated at address [……..…] for [……] has been done as per the requirements of the SSDG Grid Code (Ver. 2.3) and as per attached detailed schematic diagram.

1. The details of the equipment installed are as follows:

Equipment		Make/Model	Rating (W)	Quantity
Photovoltaic Modules				
Inverter	Output (AC) Rated Power			
	Serial No			

2. The inverter has been set as per the following settings:

Protection Parameters Settings	Trip Setting	Clearance Time	Trip Indication Provided
Over Voltage ([a]) (230 V + 10 %)			
Over Voltage (230 V + 6 %)			
Under Voltage(230 V – 6 %)			
Over Frequency ([b]) (50 Hz + 2 %)			
Under Frequency (50 Hz - 6 %)			
Loss of Mains(df/dt - Vector shift)			
Reconnection Time			
Set Active Power Limit (W) - (if applicable)			
Line impedance (ohm)			

Name of Installer Company: …….. ……(company seal)

Name of Certified Installer: …….

Signature of Certified Installer: …… Date: ……..……

Name of Applicant: ……

Signature of Applicant: …….. Date: ……..…….

ANNEX 6: Certificate for Commercial Operation

Date: ……..... **Time:** ……

1.0 Project Information

SSDG Serial No.:		Contract Ac. No.:	
Name of SSDG owner:			
Site Address :			
Type of SSDG:	PV ☐ Wind ☐ Hybrid (PV & Wind) ☐		
Capacity of SSDG:	**KW** Single phase ☐ Three phase ☐		
Permit Capacity:			
Tariff		Installation type	

2.0 CEB Meter Details & Readings

Meter	Make / Model & Serial No.	Export Readings	Import Readings	Seal No.	Phase Rotation
Import/ Export		2.8. : …… 2.8.2: …… 2.8.3 :……	1.8. : …… 1.8.2: …… 1.8.3: ……		
Production		2.8. : …… 2.8.2: …… 2.8.3: ……			

Name of SSDG Officer: ……..… Signature: ……..……

Name of District Officer: …… Signature: ……..……

3.0 Statement of SSDG Owner

I certify that the meter details and readings, as described in table above, have been taken in my presence and are correct.

Name of SSDG owner/representative: ……

Signature: …… Date: ……..

ANNEX 7: CONNECTION AGREEMENT

A Connection Agreement shall be signed by the customer upon submission of Proof of Order and Technical Details of the SSDG equipment to the CEB.