

# **LAHORE ELECTRIC SUPPLY COMPANY**



## **STANDARD OPERATING PROCEDURES ON GRID SOLAR ROOFTOP NET METERING**

**CUSTOMER SERVICES DIRECTORATE**

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**STANDING OPERATING PROCEDURE (SOP)**  
**FOR PROCESSING DISTRIBUTED GENERATION APPLICATIONS**

Pursuant to the National Electric Power Regulatory Authority (Alternative and Renewable Energy Distributed Generation and Net. Metering Regulation 2015) issued vide SRO-892 (1)/2015 dated 1st September, 2015 for implementing Solar Roof-Top net metering policy to encourage large scale generation in the sector. In this regard following SOP is hereby proposed for guidance of the field staff for expeditious implementation.

**A. Registration of Application**

1. Any person who meets the requirements of a Distributed Generator as defined under the Regulations 2(k) is required to submit application (as specified in Schedule-II of Regulations duly filled along with necessary documents) in the office of LESCO's focal person.

*The focal person for net metering program shall be the local Deputy Manager (Operation) of the concerned Division.*

2. Application can be downloaded from NEPRA's website [www.nepra.org.pk](http://www.nepra.org.pk).
3. The filled-in application along with necessary documents shall be submitted by the intending Distributed Generator to the focal person of LESCO.
4. The focal person shall accord solar net metering approvals on a first come first served basis until the grid connected Solar PV installed capacity reaches 30% of the closest upstream distribution transformer rated capacity based on the verification by the Assistant Manager (Operation) concerned.
5. The priority for such applications shall be maintained at division level for which a separate register shall be maintained for solar roof top installations.

**B. Application Processing**

1. Within five (5) working days of receiving an application LESCO shall acknowledge its receipt and inform the applicant whether the application is complete in all respects. This includes verification of arrears (if any), spot inspection by the inspection committee and submission of technical feasibility report.
2. Checks before issuing the Technical Feasibility of proposed interconnection:
  - i. The transformer shall be loaded (including proposed SRTPV system load) up to 80% of its capacity.
  - ii. Whether the proposed interconnection will require upgrading the capacity of existing distribution network.
  - iii. Phase balancing to avoid unbalancing of load in secondary circuit of distribution line.
3. In case of any missing information or documents, the applicant shall provide the same to the LESCO office within seven (7) working days of being informed by the office.

4. The LESCO office shall perform an initial review to determine whether the applicant qualifies for interconnection facility, or may qualify subject to additional requirements provided that the initial review shall be completed within twenty (20) working days.
5. In case the initial review reveals that the proposed facility is not technically feasible, the LESCO office shall return the application and communicate the reasons to the applicant within three (3) working days after the completion of initial review.
6. If the LESCO office is satisfied that the applicant qualifies as Distributed Generator, then the LESCO and the applicant shall enter into an Agreement (as per schedule-I of regulations) within ten (10) working days and LESCO office shall send a copy of the Agreement to the NEPRA Authority within seven (7) working days of the signing of the Agreement. The LESCO office shall forward the application for grant of License as specified in Schedule -III to the Authority along with following:
  - a. Agreement
  - b. Application for exemption from the requirement of section 24 of the Act as specified in Schedule-IV,
  - c. Evidence of deposit of fee as may be specified by the Authority as specified in Schedule-V
  - d. Affidavit by Distributed Generator as specified in Schedule-VI
7. Within seven working days of execution of the Agreement, the LESCO office shall issue the Connection Charge Estimate to the applicant for the proposed interconnection facility up to the interconnection point including the metering installation.
8. The applicant shall make the payment of Connection Charge Estimate within twenty (20) days of its issuance.
9. The LESCO office shall install and commission the proposed interconnection facility within thirty (30) days of the payment of demand notice by the applicant provided that the net metering arrangement shall commence upon grant of license to the Distributed Generator in accordance with Regulation-4 of these Regulations.
10. The officers & Standing Committee which will be competent to check the interconnection facility before parallel operation, issue connection charge estimate and sign the agreement with Distributed Generators are as per following detail:

- a. If SDO or XEN (Operation) office is competent to sanction the connection in respect of that category of consumers:
  - i. Interconnection facility checking/inspection by:
    - Dy. Manager (Operation),  
AM (M&T), AM (P&I)
  - ii. Issuance of connection charge estimate by:
    - Dy. Manager (Operation)
  - iii. Signing of agreement by:
    - Dy. Manager (Operation)  
Witnessed by AM (O) & LS
- b. If Manager (Operation) office is competent to sanction the connection in respect of that category of consumers:
  - i. Interconnection facility checking/inspection by:
    - Manager (Operation),  
DM (M&T), DM (P&I)
  - ii. Issuance of connection charge estimate by:
    - Manager (Operation)
  - iii. Signing of agreement by:
    - Manager (Operation)  
Witnessed by DM (O) & AM (O)
- c. If CE (P&E) / CEO office is competent to sanction the connection in respect of that category of consumers:
  - i. Interconnection facility checking/inspection by:
    - CE (P&E), Manager (Operation),  
RM (M&T), Manager GSO
  - ii. Issuance of connection charge estimate by:
    - CE (P&E)
  - iii. Signing of agreement by:
    - CE (P&E)  
Witnessed by DM (Planning) &  
AM (Planning)

**C. Some important pre-requisites:**

1. Submission of Load flow study (on PSSE software) will be compulsory for all distributed generators having installed capacity of more than 500 KW.
2. For distributed generator having capacity <500 KW may submit load flow study on FDRANA.
3. When the accumulative capacity of (already allowed) Distributed Generators become 80% of loading capacity of installed distribution transformer, agreements with new Distributed Generator will be signed subject to the augmentation of existing distribution transformer on cost deposit basis by the new distributed generator.

4. The solar PV capacity shall not exceed the sanctioned load. If a consumer proposes to install a solar PV system with the capacity that exceeds the service connection sanctioned load, an application for EOL shall be submitted by the consumer in addition to the solar net metering application. EOL applications shall be processed as per the existing standard procedures.
5. Safety inspection for grid connected Solar PV installation should be obtained from the appropriate authorities (the inspection authority) as mentioned below:

Load up to 10 kW	A committee comprising of the concerned Deputy Manager (M&T) and Assistant Manager (Operation) shall be the inspecting authority.
Load above 10 kW	A committee comprising of the concerned Deputy Manager (M&T) and Deputy Manager (Operation) shall be the inspecting authority.

*Safety inspections shall be carried out by the inspection authority within 10 (Ten) working days from the date of readiness intimation by the applicant. Safety certificates shall be issued within 5 (five) working days from the date of safety inspection or rectification of defects, if any.*

6. Mandatory safety precautions/features which have to be taken into consideration as part of the grid connected solar PV system installations are:
  - a. An inbuilt Inverter relay which trips on grid failure and thus prevents any solar power injection to the grid when there is no power in grid (anti-islanding protection shall be tested by the respective officers during routine service connection inspections), and necessary protection arrangements shall be made when there is no grid supply on single/two/three phases. The inspection authority shall ensure the protection before commissioning. The applicant's installation shall be disconnected in the event of such exigencies to prevent accident or damage to men and material.
  - b. The Solar PV system should be separately grounded/ earthed. Lightning arrestors also to be provided for SPV. Manual isolator switch with locking facility shall be provided at 'Ground Floor'.
7. A single bi-directional service connection meter shall be installed to measure import and export (kWh) separately. For existing service connections, the uni-directional service connection meter shall be replaced with a bi-directional service connection meter. Bi-directional service connection meter's accuracy and facilities shall be the same as applicable to the standard uni-directional meters for the relevant type of service connection and tariff.

**D. Distributed Generation Facility Design and Operating Requirements:**

Pursuant to Clause-9 "Protection Requirements" of the Alternative and Renewable Energy Distributed Generation and Net Metering Regulations, 2015 for implementing solar roof-top net metering policy, following protection requirements are hereby proposed to be incorporated in design of the system.

### 1. **Single Line Diagram:**

The protection and control diagrams for the interconnection of the Distributed Generator shall be in accordance with Single Line Diagram, to be approved by the LESCO prior to the commissioning of the system.

2. Distributed Generator shall be responsible for installation of all of the equipment and protective devices to be used for the interconnection.

### 3. **Earthing Protection:**

A minimum of two separate dedicated and interconnected earth electrodes must be used for the earthing of the solar PV system support structure with a total earth resistance not exceeding 5 ohms as below:

(i) Equipment earth (DC) &

(ii) System earth (AC)

Both equipment earth (DC) and system earth (AC) shall be checked for proper earthing.

#### ➤ **Equipment earth (DC)**

All the non-current carrying metal parts such as PV modules, DCDB are bonded together and connected to earth to prevent shocks to the manpower and protection of the equipment.

#### ➤ **System earth (AC)**

All the non-current carrying metal parts such as ACDB, Lightning Arresters are bonded together and connected to the existing earth.

### 4. **Surge Protection:**

- Surge protection shall be provided on the DC side and the AC side of the solar system.
- The DC surge protection devices (SPDs) shall be installed in the DC distribution box adjacent to the solar grid inverter.
- The AC SPDs shall be installed in the AC distribution box adjacent to the solar grid inverter.
- The SPDs earthing terminal shall be connected to earth through the above mentioned dedicated earthing system.
- The Lightning Arresters need to be provided for the SRTPV buildings which are of more than 15 meters height only.

5. Earthing shall be done in accordance with Standard Design Instructions issued by Chief Engineer (D&S) NTDCL.

6. The consumer shall be present at the time of synchronization of the installation.
7. The consumer shall provide suitable capacity of Porcelain Cutouts (100 Amps, or 200 Amps) to enable linemen to disconnect the installation so as to provide a safe zone for maintenance works.
8. If the installation satisfies all the above conditions the synchronization of the SRTPV system shall be carried out by the concerned Assistant / Deputy Manager (Operation) along with M&T staff within three (3) working days from the issue of approval for synchronizing and commissioning.
9. At the time of commissioning, the installed meters shall be jointly inspected and sealed on behalf of both the parties and shall be tested or checked only in the presence of consumer or his/her representatives.
10. The concerned Assistant / Deputy Manager (Operation) will issue synchronization certificate to the applicant of the SRTPV system after synchronization and commissioning.

**E. Periodical inspections:**

- Both uni-directional and bi-directional energy meters are to be tested as per schedule by M&T staff once in 6 months.
- The inverter functionality of every installation is to be checked by M&T staff once in 6 months.
- Periodical test reports/inspection reports shall be submitted to the concerned Assistant Manager (Operation) and Deputy Manager (Operation).

**F. Billing procedure:**

Pursuant to Clause-14 “Billing for Net Metering” of the Alternative and Renewable Energy Distributed Generation and Net Metering Regulation 2015 for implementing solar roof-top net metering policy, following procedure is hereby proposed to be adopted:

- The consumer shall receive a monthly net import/export bill indicating either net export to the grid or net import from the grid.

“Import”- means energy supplied by the LESCO grid.

“Export”- means energy delivered to the LESCO grid.

- The meter reader has to capture import & export energy and other billing parameters recorded by the bi-directional meter.
- In case of net import bill, the Distributed Generator shall be billed for the net kWh in accordance with applicable tariff.



- In case, the export energy is more than the import, the net kWh shall be credited against Distributed Generator next billing cycle for future consumption, or shall be paid by the LESCO to the Distributed Generator quarterly. Provided that where the Distributed Generator is to be paid, the kWh in a month will be charged at the tariff of that respective month.
- The tariff payable by LESCO shall only be the off-peak rate of the respective consumer category of the respective month and other rates such as variable charges for peak time, fixed charges, fuel price adjustment, duties / levies will not be payable by the LESCO.

#### **G. General Guidelines**

- The applicant is required to install the SRTPV system through system installer who has experience in design, supply and installation of SRTPV system.
- The SRTPV system should comply with the relevant IEC technical standards.
- The installation work has to be carried out as per the approved drawing and as per standards.
- In case the installed (also read proposed) capacity of the SRTPV system is higher than the sanctioned load of the consumer, which consequently requires an up-gradation in the infrastructure (service line meter with CT (if required), transformer upgrading (if required), the consumer will have to upgrade at his / her / its own cost.
- The applicant shall provide check meters when the SRTPV system is more than 20 kWp.

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## Solar Net Metering Technical Feasibility Report

### A. Particulars of the Applicant:

- i. Name of the Applicant:
- ii. Address:
- iii. Telephone No/Mobile No:
- iv. Email address:
- v. Reference No. of existing connection
- vi. Sanctioned Load in kW (A):
- vii. Applicable tariff:
- viii. Detail of existing energy meter
  - a) Make and type
  - b) Single / three phase:
  - b) Capacity in ampere:
  - c) Direct reading or CT operated:

### B. Name of:

- a) Operation Sub-Division
- b) Feeder/code
- c) 132/11.5 KV Grid Station:

### C. Details of Distribution Transformer:

- i. Capacity of Distribution Transformer in KVA (B)
- ii. Voltage ratio of Distribution Transformer
- iii. Solar PV capacity already connected to this Distribution Transformer in KW (C):
- iv. Proposed Solar PV capacity in KW (D):
- v. Total Solar PV capacity including the proposed new capacity: (E = C + D):

Note: The proposed solar PV capacity addition is technically feasible if

- a) The total solar PV capacity (E) in kW is not more than 30% of the Distribution Transformer capacity in KVA (B)  $[E \leq B \times 30\%]$  and
- b) The proposed solar PV capacity in kW (D) does not exceed the sanctioned load of the service connection in kW (A)  $[D \leq A]$ .

### D. Feeder Details (Applicable for the HT consumers applied for LT connectivity).

- i. Name of the feeder/code
- ii. Name of Grid Station from which the feeder is emanating with voltage ratio
- iii. Type and size of the conductor
- iv. Current carrying capacity of the feeder
- v. Maximum load reached on the feeder in KW
- vi. Total connected Distribution Transformer capacity on this 11KV feeder (KVA)
- vii. SPV generators connected on this feeder, if any, and their capacity in KW.

### E. Conclusion:

Whether it is technically feasible to connect the proposed solar PV system to the service connection (Yes or No):

Deputy Manager (Operation)\_\_\_\_\_ Deputy Manager (M&T)\_\_\_\_\_

**Inspection / Test Check Proforma****A. Service Connection Details:**

- i. Name of the Consumer:
- ii. Address:
- iii. Telephone No/Mobile No:
- iv. Email address:
- v. Reference No. of existing connection
- vi. Applicable tariff:
- vii. Details of already existing (removed energy meter)
  - a) Make and type
  - b) Meter Readings
  - c) Serial number
  - d) Month / year of manufacture

**B. Details of the Newly Installed Bidirectional Meter**

- i. Make and type
- ii. Serial number
- iii. Month / year of manufacture
- iv. Capacity:
- v. Meter constant (for CT-operated meters):
- vi. Import register reading (kWh):
- vii. Export register reading (kWh):
- viii. Accuracy .....

**C. Solar Generation Check**

- i. Make and type
- ii. Serial number
- iii. Month / year of manufacture
- iv. KWH Reading
- v. Meter constant (for CT-operated meters):
- vi. Accuracy.....

**D. Solar Grid Inverter**

- i. Make:
- ii. Serial number:
- iii. Capacity:
- iv. Input DC voltage range:
- v. Output AC voltage range:
- vi. Anti-Islanding Protection Check - if the grid fails the status of the contactor (on or off)

**E. Solar PV modules**

Total capacity of solar modules (kW):

Deputy Manager (Operation)\_\_\_\_\_

Deputy Manager (M&T)\_\_\_\_\_

**Sample Specifications of Solar Grid Inverter for guidance purpose**

Total output power (AC)	To match solar PV plant capacity while achieving optimum system efficiency
Input DC voltage range	As required for the solar grid inverter DC input.
Maximum power point (MPPT) tracking	Shall be incorporated
Number of independent MPPT inputs	1 or more
Operation AC voltage	Single phase 230V or Three phase 415V (+ 12.5%, -20%)
Operating Frequency range	47.5 – 52.5 Hz
Nominal frequency	50 Hz
Power factor of the inverter	>0.98 at nominal power
Total harmonic distortion	Less than 3%
Built-in Protection	AC high / low voltage; AC high /low frequency
Anti-islanding protection	As per VDE 0126-1-1, IEC 60255.5 / IEC 60255.27
Operating ambient temperature range	-10 °C to +60 °C
Humidity	0 – 95% Rh
Inverter efficiency	>=95%
Inverter weighted efficiency	>=94%
Protection degree	IP 65 for outdoor mounting, IP 54 for
Communication interface	RS 485 / RS 232 / RJ45
Safety compliance	IEC 62109-1, IEC 62109-2
Environmental Testing	IEC 60068 - 2 (1,2,14,30)
Efficiency Measurement Procedure	IEC 61683
Cooling	Convection
Display type	LCD for data display. LCD / LED for status display
Display parameters to include	Output power (W), cumulative energy (Wh), DC voltage (V), DC current (A), AC voltage (V), AC frequency (Hz), AC current (A), cumulative hours of operation (h).

**Note:****Inverter Standards**

Inverter should comply with IEC 61683 for efficiency and measurements and should comply IEC 60068 -2 (1, 2, 14, 30) standard for environmental testing.

Inverter should supervise the grid condition continuously and in the event of grid failure (or) under voltage (or) over voltage, solar system should be disconnected by the circuit breaker/auto switch provided in the inverter.

**LAHORE ELECTRIC SUPPLY COMPANY LIMITED****CHECKLIST FOR SOLAR ROOFTOP PV GRID SAFETY QUALIFICATION****1.0. Solar RTPV – Customer and Location Data**

1	Customer Name	
2	Address	
3	Customer Contact - Email	
4	Customer Contact – Mobile No.	
5	SRTPV Installer – Name & Address	
6	LESCO Officer in Charge	

**2.0 Component Inspection Checklist**

Sr. No	Item Type	YES	NO
1	Installation layout – is it as per drawing?		
2	Inverter IEC standards qualified		
3	PV panel IEC standards qualified		
4	PV isolators / PV cables IEC standards qualified		
5	AC disconnect manual switch provided		
6	Meters checked by M&T		
7	Any other critical component IEC standards certified		

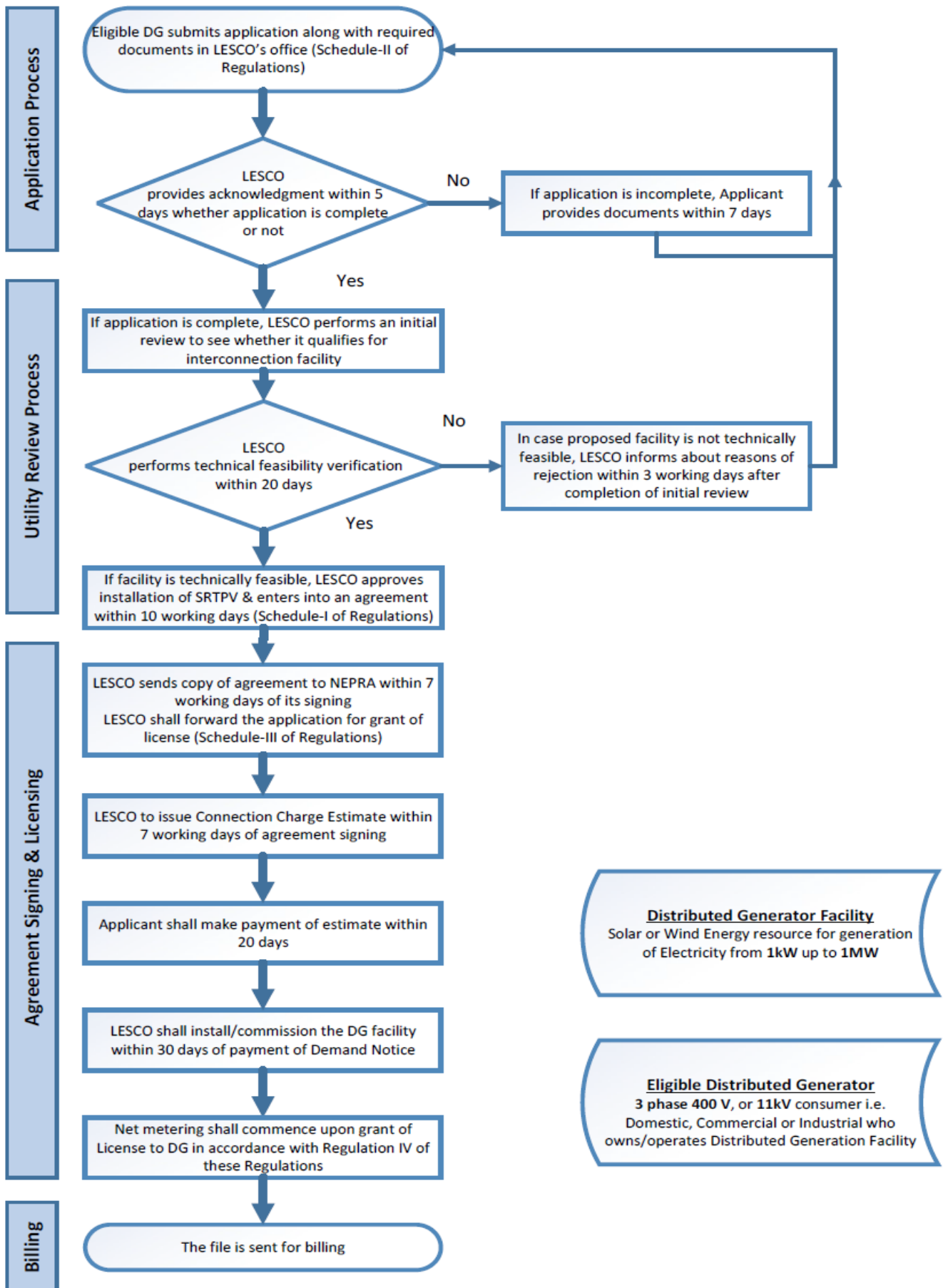
**3.0 Grid Functional Safety Checklist**

Sr. No	Item Type	YES	NO
1	Check-PV Inverter and islanding (utility side) Disconnect grid and check whether PV generator seizes generation immediately		
2	Check reconnect time by reconnecting the grid: PV Generator reconnects minimum 60 seconds later (Single Phase) or minimum 300 seconds later (three phase connectivity)		
3	Bi directional flow recorded on LESCO Meter		
4	Consumption (import) only mode OK?		
5	PV inverter anti islanding tested at array side		
6	Solar generation meter OK?		
7	Check all earthings provided at ACDB/DCDB/LA		

It is certified that the PV installation is qualified to be connected to LESCO Grid.

**Dy. Manager (Operation)**  
\_\_\_\_\_  
**Division LESCO**

# Flow Chart of Interconnection Process



### Single Line Diagram of On Grid Roof Top PV System for Net Metering Interconnection

