Guidelines for Interconnecting Solar Mini Grids to Distribution Network

NIGERIAN ELECTRICITY MANAGEMENT SERVICES AGENCY
(NEMSA)

Guidelines for Interconnecting Solar Mini-Grids to Distribution Networks

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DEUTSCHE ZUSAMMENARBEIT

Preface

The Nigerian Electricity Management Services Agency (NEMSA) was established by NEMSA Act 2015 (now Electricity Act 2023) to carry out the functions of Enforcement of Technical Standards and Regulations, Technical Inspection, Testing and Certification of all categories of Electrical Installations across the power value chain (Generation, Transmission, Distribution, Utilisation, Renewable Energy projects for electricity generation, etc.) Including Electricity Meters and Instruments to ensure the efficient production and delivery of safe, reliable and sustainable electricity power supply and guarantee safety of lives and properties in the Nigerian Electricity Supply Industry (NESI), other allied industries and premises.

The advancement of solar mini-grids in Nigeria, particularly for unserved and underserved communities, highlights the need for clear technical, regulatory, and operational guidance. The Guidelines for Interconnecting Solar Mini-Grids to Distribution Networks, published by NEMSA, were developed with technical support from the Nigerian Energy Support Programme (NESP), co-funded by the European Union and the Government of Germany, and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in collaboration with the Federal Ministry of Power.

These Guidelines outline the procedures, models and standards for interconnecting Solar Mini-Grids to Distribution Networks, which are critical to ensuring the safety, reliability, and efficient operation of interconnected power systems. They address existing gaps by clearly defining interconnection models, processes, and technical requirements, thereby reducing uncertainties, minimising project development risks, and strengthening coordination among stakeholders, including mini-grid developers, Distribution Licensees, and regulators such as the Nigerian Electricity Regulatory Commission.

Furthermore, these Guidelines align with the provisions of the Electricity Act 2023, the Mini-Grid Regulations 2026, and other extant national and international standards, including International Electrotechnical Commission (IEC) standards. They are intended to ensure that all interconnections are carried out without compromising grid stability, power quality, safety, and environmental sustainability, while also promoting investment and innovation in Nigeria’s renewable energy sector.

NEMSA remains committed to periodic review and continuous improvement of these guidelines in response to technological advancements and sectoral developments.

Acknowledgements

The Nigerian Electricity Management Services Agency (NEMSA) would like to acknowledge the cooperation of all the key NESI stakeholders that took part in the development of these Guidelines for Interconnecting Solar Mini-Grids to Distribution Networks, particularly the Nigerian Energy Support Programme (NESP), co-funded by the European Union and the German Government and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in collaboration with the Federal Ministry of Power (FMP).

Engr. Olusegun Adesayo

Managing Director/CEO & CEIF

Foreword

The Nigerian Electricity Management Services Agency (NEMSA), established pursuant to the NEMSA Act, 2015 (now codified in the Electricity Act, 2023), is statutorily mandated to carry out the enforcement of technical standards and regulations, and the inspection, testing, and certification of all categories of electrical installations, electricity meters, and related equipment within the Nigerian Electricity Supply Industry (NESI).

In discharge of this mandate, NEMSA is required to ensure that electrical infrastructure and associated systems deployed across the sector comply with approved technical, safety, quality, and performance standards.

The increasing deployment of Solar Mini-Grids in Nigeria has contributed significantly to improved electricity access, particularly in unserved and underserved communities. As grid expansion progresses and the sector continues to evolve, the interconnection of Solar Mini-Grids to Distribution Networks has become a matter of growing technical, operational, and regulatory importance. Such interconnection must be undertaken within a clearly defined framework to ensure safety, system compatibility, network integrity, power quality, and compliance with extant laws, regulations, codes, and standards. It is in this regard that these Guidelines for Interconnecting Solar Mini-Grids to Distribution Networks have been developed.

This document provides a structured framework for the safe, orderly, and technically compliant interconnection of Solar Mini-Grids to Distribution Networks in Nigeria. It sets out the applicable interconnection arrangements, the roles and responsibilities of relevant parties, the procedural requirements for implementation, and the technical conditions necessary for approval, inspection, testing, certification, operation, and continued compliance.

The Guidelines are intended to serve as a technical reference for mini-grid developers, distribution licensees, investors, engineers, inspectors, consultants, and other stakeholders involved in the design, review, approval, execution, and operation of interconnected mini-grid systems.

The provisions contained herein should be read and applied in conjunction with all applicable electricity sector laws, subsidiary regulations, technical codes, standards, and directives issued by the relevant competent authorities. Compliance with these Guidelines shall not relieve any person, operator, developer, or licensee of the obligation to comply with any other applicable statutory or regulatory requirement.

NEMSA remains committed to promoting safe, reliable, and standards-compliant electricity infrastructure in Nigeria. It is expected that these Guidelines will enhance regulatory clarity, strengthen technical due diligence, support sector coordination, and facilitate the responsible integration of Solar Mini-Grids into Distribution Networks in a manner that advances national electrification objectives.

I commend this document to all stakeholders for strict compliance and guided application.

Engr. Olusegun Adesayo

Managing Director/CEO & CEIF

Contents

Acronyms

AMI	Advanced Metering Infrastructure
CAC	Corporate Affairs Commission
DisCo	Distribution Company / Distribution Licensee
EA 2023	Electricity Act 2023
EIA	Environmental Impact Assessment
ESMP	Environmental and Social Management Plan
FRT	Fault Ride-Through
IEC	International Electrotechnical Commission
LVRT	Low Voltage Ride-Through
MoU	Memorandum of Understanding
MV	Medium Voltage
NEMSA	Nigerian Electricity Management Services Agency
NERC	Nigerian Electricity Regulatory Commission

1 Definitions

Anti-Islanding Protection	Means a safety mechanism that prevents a mini-grid from continuing to power a location when disconnected from the main grid, ensuring the safety of utility personnel and equipment.
Compensation Buy-Out	Means a financial arrangement where the assets of an existing Solar Mini-Grid are purchased by the DisCo, thereby assuming responsibility for electricity supply in the area.
Dispatchability	Means the ability of a generation facility to regulate its output in response to commands or changing grid conditions, including curtailment or load-following.
Distribution Licensee or DisCo	Means a licensed electricity distribution company authorized by the Nigerian Electricity Regulatory Commission (NERC) to operate the distribution network within a specified franchise area.
Fault Ride-Through (FRT)	Means the capability of a mini-grid to remain connected and operational during short-term voltage or frequency disturbances on the grid.
Grid-Tie Inverter	Means an inverter that connects a mini-grid's generation system to the utility grid, converting DC power to AC and synchronizing with the grid's voltage and frequency.
Hosting Capacity Information (HCI)	Means feeder-level or network-level technical information published or confirmed by a Distribution Licensee, in the form approved by the Commission, showing the indicative ability of a feeder or network segment to accommodate an interconnected mini-grid without material adverse effect on safety, stability, voltage, protection, or power quality. HCI shall be updated at least once every twelve (12) months, within sixty (60) days of any material feeder change, or as directed by the Commission.
Hybrid (SPP & SPD)	Means an interconnection model in which the mini-grid operator both generates electricity for injection into the distribution network and purchases electricity from the grid for retail.
IEC (International Electrotechnical Commission)	Means a global standards organization that prepares and publishes international standards for electrical, electronic, and related technologies, widely referenced in the testing, safety, and performance of solar mini-grid components.

Interconnected Mini-Grid	Means a mini-grid connected to, and operated in coordination with, a Distribution Licensee's network, with installed generation capacity up to 10 MW per site, in accordance with the Mini-Grid Regulations, 2026.
Limited Export Interconnected Project	Means an interconnected mini-grid permitted to export electricity to the Distribution Licensee's network at the Point of Common Coupling (PCC), subject to a fixed approved maximum export limit.
Managed Export Interconnected Project	Means an interconnected mini-grid permitted to export electricity to the Distribution Licensee's network at the PCC, subject to variable, time-varying or dynamically controlled export limits, operating windows, communication requirements or control instructions approved by the Commission.
Memorandum of Understanding (MoU)	Means a formal agreement between the Solar Mini-Grid Developer and the DisCo outlining intentions, shared responsibilities, and information exchange prior to formal interconnection.
Multi-Mode Inverter	Means an inverter capable of operating both in off-grid and grid-connected modes, allowing the mini-grid to switch between standalone and interconnection operations.
Nigerian Electricity Management Services Agency (NEMSA)	Means a regulatory body responsible for the enforcement of technical standards, inspections, testing, and certification of electrical installations across Nigeria.
Nigerian Electricity Regulatory Commission (NERC)	Means the statutory body tasked with regulating the electricity sector in Nigeria, including licensing, tariff setting, and issuance of technical and operational codes.
Non-Export Interconnected Project	Means an interconnected mini-grid permitted to import electricity from the Distribution Licensee but not permitted to export electricity to the Distribution Licensee's network during normal operation, except where expressly approved by the NERC.
Point of Common Coupling (PCC)	Means the electrically defined point at which an interconnected mini-grid connects to the Distribution Licensee's network and at which the ownership, operational, protection, metering, and commercial boundaries of the interconnection are identified.

Radial Network	Means a type of electricity distribution network where power flows in a single direction from the substation to the end-user without alternate paths.
Small Power Distributor (SPD)	Means a mini-grid operator that purchases bulk electricity from the distribution network and retails it to customers within its service area.
Small Power Producer (SPP)	Means a mini-grid operator that generates electricity and injects it into the distribution network for sale and delivery by the DisCo.
Short-Form System Impact Study Confirmation	Means a written confirmation issued by a Distribution Licensee, in the standard template approved by the Commission, confirming that an eligible interconnected mini-grid conforms to the applicable published Hosting Capacity Information, standard technical conditions, operating mode, and project single-line diagram.
Solar Mini-Grid (SMG)	Means a localized electricity generation and distribution system, primarily powered by solar energy, designed to operate in isolation or in conjunction with the main grid to supply power to a defined community or service area.
System Impact Study (SIS)	Means a detailed engineering assessment conducted to determine the technical effect of connecting a mini-grid generation source, load, or other facility to the Distribution Licensee's network, including impacts on safety, reliability, stability, voltage, protection coordination, power quality, metering, and network operation.
Technical and Investment Plan	Means a comprehensive proposal submitted by the mini-grid developer to the DisCo outlining the technical configuration, interconnection approach, capital expenditure, and operational strategy for grid integration.
Tripartite Agreement	Means the contract executed by the Interconnected Mini-Grid Developer, the Distribution Licensee and the Connected Community, and approved by the Commission.

2 Introduction

2.1 Background

Solar Mini-Grids and national grids have so far been complementary to each other in developing countries. While the national grid is built as a centralized, large infrastructure extending outwards to serve customers, Solar Mini-Grids are built in unserved and underserved communities. With the advancement of national grid coverage, combined national grid and Solar Mini-Grid solutions have already started gaining momentum in many countries, including Nigeria.

The Solar Mini-Grid sector in Nigeria has until recently focused mostly on unserved areas where mini-grids are perceived as one of the most cost-efficient solutions for providing reliable and sustainable electricity to communities. However, in grid-connected areas that are underserved due to an insufficient grid, Interconnected Mini-Grid solutions can bring reliable power supply to the populace and also reduce pressure on the national grid while supporting economic and productive activities.

The Nigerian Mini-Grid Regulations clearly state the possible modalities for how mini-grid developers can connect their mini-grid systems to the national grid. However, a guideline for interconnecting Mini-Grids to the distribution network is not available at this point. As there is no standardised process due to an evolving market, interconnected Mini-Grid projects are considered on a case-by-case basis. This ad-hoc approach may result in increased costs, either as project development or overhead costs for the involved parties, as well as a lack of clarity in terms of timelines, allocation of responsibilities, essential equipment, and ultimately effective interconnection. This is why interconnection guidelines are necessary to provide clear directions through streamlined processes.

2.2 Objectives of the Guidelines

The main objectives of these guidelines are:

1. To operationalize Section 9 of the Mini-Grid Regulations 2026, which provides for the interconnection of mini-grids to Distribution Networks;
2. To highlight the technical and regulatory requirements for integrating Solar Mini-Grids into the Distribution Network;
3. To inform Solar Mini-Grid developers and Distribution Licensees of the possible interconnection models and guide the selection of the most appropriate option based on technical, commercial, and community considerations.
4. To assist the stakeholders in understanding the process and measures for integrating Solar Mini-Grids into the Distribution Network without compromising adequacy, safety, reliability or affordability of power supply; and
5. To guide the installation of interconnection systems and equipment to ensure that the public and the environment are adequately protected.

2.3 Scope of the Guidelines

1. The Guidelines describe the process, standards and models for interconnecting Solar Mini-Grids to a Distribution Network. These Guidelines shall also specify the roles of all stakeholders involved in the development and interconnection process of Solar Mini-Grids to a Distribution Network.
2. The enforcement of the Guidelines shall be carried out by NEMSA and implemented by the Distribution Licensee in close collaboration with the Solar Mini-Grid Developer.
3. The Guidelines shall be read and implemented in conjunction with extant laws, regulations, standards and codes, which include the following:
    a) Laws of the Federal Republic of Nigeria
    b) The Electricity Act, 2023
    c) Regulations and Codes from NERC, including but not limited to:
        i. The Nigerian Electricity Health and Safety Code, 2014
        ii. The Nigerian Electricity Supply and Installation Standards (NESIS) Regulations, 2015
        iii. The Grid Code, 2018
        iv. The Distribution Code, 2014
        v. The Metering Code V02, 2014
        vi. Nigerian Electricity Smart Metering Regulations, 2015
        vii. The Mini-Grid Regulations, 2026
        viii. Other technical regulations, guidelines and codes issued by NERC from time to time.
    d) Guidelines developed by NEMSA that are in line with the extant laws and regulations, including but not limited to:
        i. This Guideline
        ii. Guidelines for the Inspection of Solar Mini-Grids in Nigeria, 2020
        iii. The Nigerian Electrical Installations and Construction Guidelines Manual, Distribution Subsector, Volume 1-5, 2020
        iv. Other technical guidelines and codes developed by NEMSA from time to time
    e) International Electrotechnical Commission (IEC), in relation to Solar Mini-Grids, including but not limited to:
        i. IEC 62446-1:2016+A1:2018: PV Systems – Requirements for testing, documentation and maintenance – Part 1: Grid-connected systems – Documentation, commissioning tests and inspection
        ii. IEC 60896-21:2004: Stationary lead-acid batteries – Part 21: Valve regulated types – Methods of test

iii. IEC 62485-1:2015: Safety requirements for secondary batteries and battery installations – Part 1: General safety information

iv. IEC 62619:2017: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications; and

v. IEC 62620:2014: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial applications

4. In the case of conflicts between the present Guidelines and other NEMSA Guidelines, these Guidelines shall take precedence over other NEMSA Guidelines where the said conflict is in relation to interconnecting Solar Mini-Grids to Distribution Networks, as long as they are in line with the extant laws and regulations.

5. The Guidelines shall be subject to a review by NEMSA every 3 years or at any other time as suggested by NEMSA.

3 Interconnection Models

The interconnection models shall be any of the following:

3.1 Small Power Producer (SPP)

The Solar Mini-Grid developer shall generate electricity and inject it into the Distribution Network while the DisCo shall take over the retailing of the electricity to the mini-grid customer. This model operates under a Limited Export or Managed Export arrangement in accordance with the Mini-Grid Regulations, 2026.

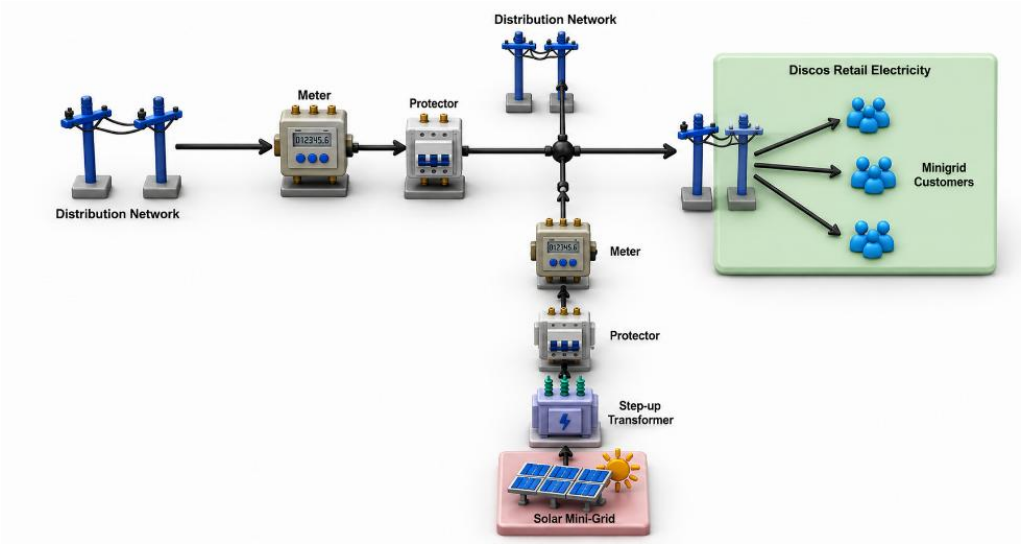

Figure 1: Schematic Diagram of a SPP Model

3.2 Small Power Distributor (SPD)

The Solar Mini-Grid developer shall decommission the Solar Mini-Grid, purchase bulk electricity from the Distribution Network and retail the purchased electricity to the mini-grid customer. This model operates under a Non-Export arrangement, and the transition process shall follow the provisions of the NERC Mini-Grid Regulations 2026.

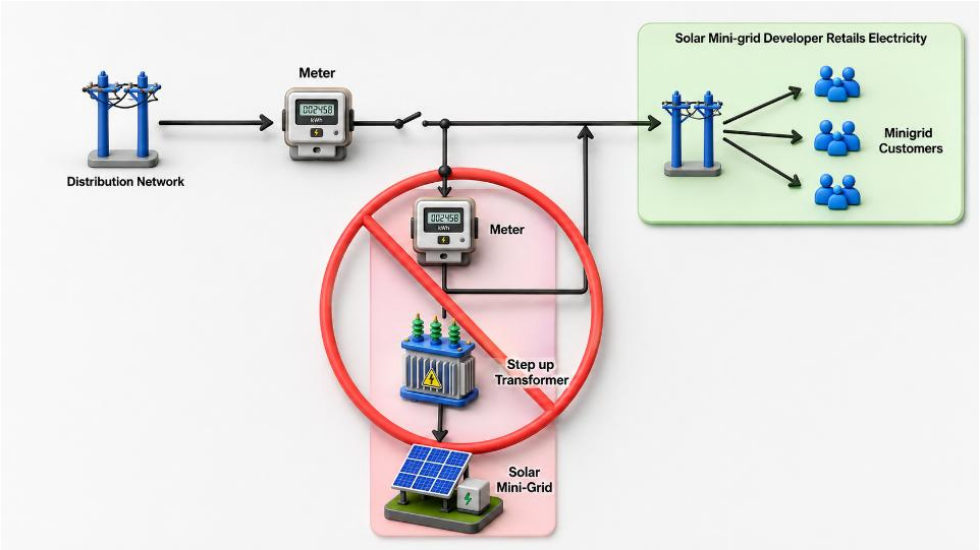

Figure 2: Schematic Diagram of a SPD Model

3.3 Hybrid (SPP & SPD)

The Solar Mini-Grid developer shall generate electricity and inject it into the Distribution Network and retail electricity to customers, some of which may be from the grid.

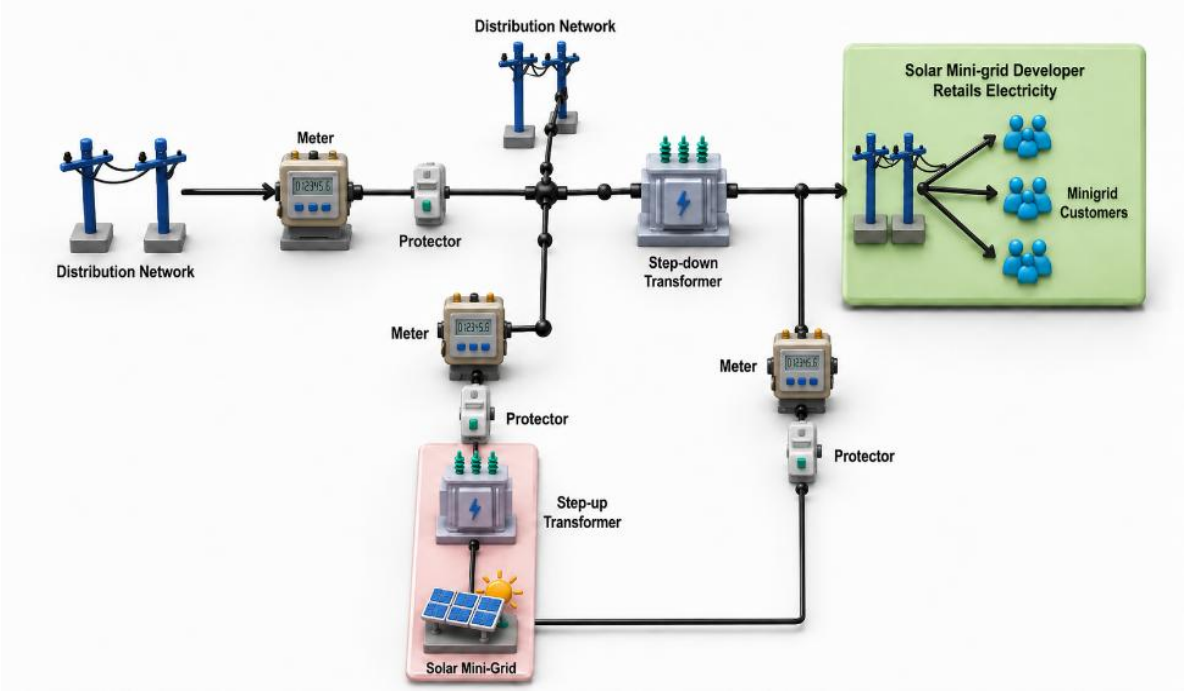

Figure 3: Schematic Diagram of a Hybrid Model

3.4 Compensation Buy-Out

The Solar Mini-Grid assets shall be purchased by the DisCo from the Solar Mini-Grid developer in accordance with the applicable compensation provisions of the Mini-Grid Regulations 2026.

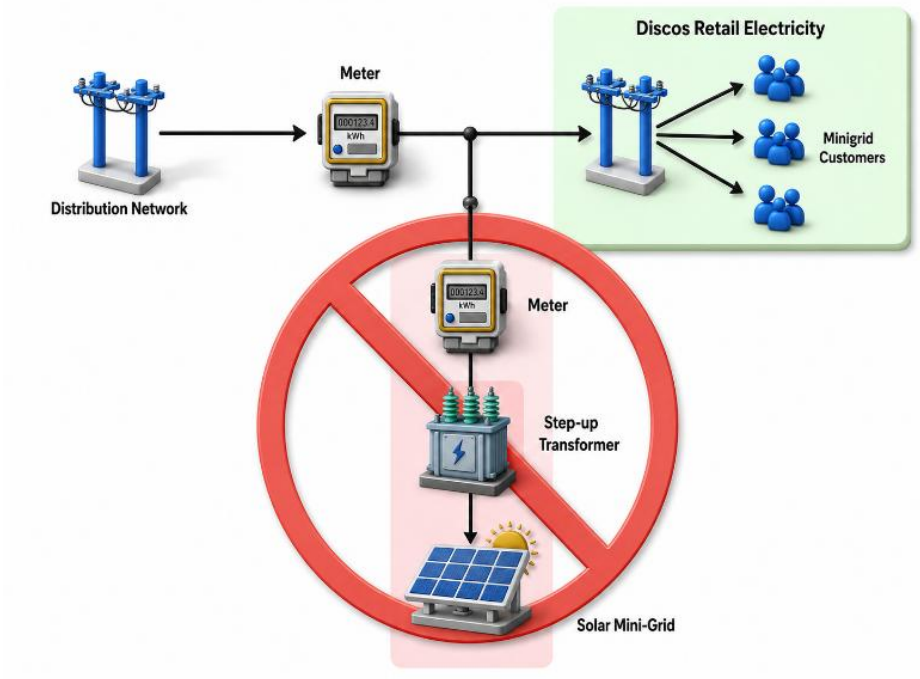

Figure 4: Schematic Diagram of Compensation Buy-Out Model

3.5 Time-Split Supply Model (TSS)

The Solar Mini-Grid Developer shall retail electricity to the mini-grid customers from the Distribution Network and the Solar Mini-Grid generator at different, pre-agreed time windows. The supply schedule and operational switching arrangements shall be jointly agreed upon by the DisCo and the Solar Mini-Grid developer. The arrangement may operate as a Non-Export Interconnected Project unless parallel operation or export to the Distribution Licensee's network is expressly approved by the Commission.

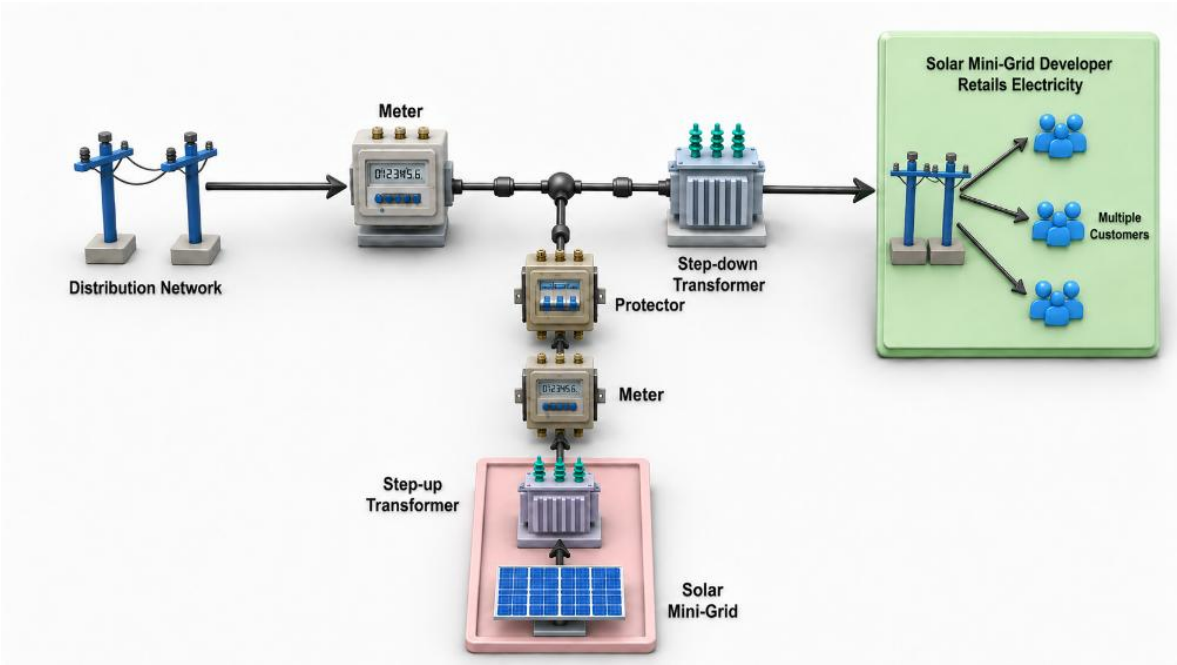

Figure 5: Schematic Diagram of a TSS Model

4 Interconnection Process

1. A lean approach has been adopted for the interconnection of Solar Mini-Grids in Nigeria. The interconnection process can start from the onset of Solar Mini-Grid operations or after the distribution network grid arrives at a Solar Mini-Grid-served community.
2. The interconnection process outlined shall cover all ranges of Solar Mini-Grid capacity as provided in the Mini-Grid Regulations 2026.

4.1 Interconnection Process for a Solar Mini-Grid with a Distribution Network

4.1.1 Preliminary Stage

1. **Review of Hosting Capacity Information (HCI) and Site Status:** Before submitting an interconnection request for a proposed or existing Solar Mini-Grid site, the Solar Mini-Grid developer shall review the DisCo's published HCI and relevant site information to identify:
    a) The proposed or existing Point of Common Coupling (PCC);
    b) The voltage level, feeder, substation, and available hosting capacity;
    c) The applicable unserved or underserved area classification;
    d) Any expected energisation window, network expansion plan, or known technical limitation;
    e) Whether the project may qualify for the simplified interconnection pathway or requires a full System Impact Study; and
    f) For an existing Solar Mini-Grid site, whether the request relates to grid arrival, conversion from isolated to interconnected operation, modification of an existing arrangement, export capability, import from the Distribution Network, or any other transition arrangement under the Mini-Grid Regulations, 2026.
2. **Filing of Application:** The interconnection process starts with the Solar Mini-Grid developer sending an interconnection request to the DisCo. An application form in Annex A shall be filled out by the mini-grid developer and submitted to the DisCo.
3. **Signing of Memorandum of Understanding (MoU):** The Solar Mini-Grid developer shall sign an MoU with the DisCo for unfettered information sharing.
4. **Sharing of Technical Information:** After signing the MoU, the Solar Mini-Grid developer shall share the technical information as contained in Annex B with the DisCo while the DisCo shall share the technical information as contained in Annex C.
5. **Validation of Suitability for Interconnection:**
    a) The DisCo shall validate the suitability for interconnection provided that:

i. The Point of Common Coupling (PCC) is on a 'radial' distribution network.

ii. The AC capacity of the Solar Mini-Grid shall not exceed the available hosting capacity of the line, section, feeder, or substation, unless reinforcement or other technical conditions are approved.

iii. The expected PCC shall be free of any known stability, reliability, and safety issues.

iv. The Solar Mini-Grid equipment/components specifications comply with Grid Code, Distribution Code, Nigerian Industrial Standards (NIS)/IEC, the Nigerian Metering Code V02, 2014 and the Nigerian Electricity Smart Metering Regulations.

v. The Solar Mini-Grid's generated fault current shall be between 1.25 and 1.5 times its normal operating current for a brief period.

vi. With the introduction of the Solar Mini-Grid, any equipment or protective equipment shall be able to handle expected maximum loads and fault currents with appropriate safety margins.

vii. The project qualifies for either a Short-Form System Impact Study Confirmation or a full System Impact Study, as applicable.

b) The DisCo shall fill in the feedback form in Annex D and send it to the Solar Mini-Grid developer.

c) In the event that the Solar Mini-Grid does not satisfy the criteria in (a) above, the DisCo shall carry out a supplementary study on the Solar Mini-Grid to explore interconnection options.

4.1.2 Permitting Stage

1. Submission of Full Technical and Investment Plan:

a) The Solar Mini-Grid developer shall submit to the DisCo a full proposal containing a technical and investment plan in accordance with Annex E, along with a draft tripartite agreement negotiated with the community, using Schedule 10 of the Mini-Grid Regulations, 2026 as a guide.

b) The technical and investment plan shall include the relevant Hosting Capacity Information, proposed or existing Point of Common Coupling (PCC), applicable operating mode, Short-Form System Impact Study Confirmation or System Impact Study, metering and protection arrangement, tariff proposal, and any applicable import, export, time-split supply, or commercial arrangement.

c) For an existing Solar Mini-Grid site, the technical and investment plan shall also reflect the as-built system configuration, existing approvals, asset condition, current operational status, customer base, and any required rectification, reinforcement, metering upgrade, protection adjustment, or operational modification.

d) The DisCo shall review the submitted proposal and tripartite agreement, and seek clarification and/or provide feedback on the tripartite agreement where necessary.

e) The DisCo shall send an approval letter to the Solar Mini-Grid developer and invite them to sign a tripartite agreement.

2. **Execution of Tripartite Agreement:** The tripartite agreement shall be signed by the DisCo, Solar Mini-Grid Developer, and the Authorised Representative of the Community(ies).

3. **Filing of Application for a Permit with NERC:** The Solar Mini-Grid developer shall complete all the required documents and conditions, with an attached copy of the executed tripartite agreement, as specified in the Mini-Grid Regulations, 2026, and submit the same to NERC.

4.1.3 Completion and Inspection Stage

1. **Plant installation and completion:** The Solar Mini-Grid developer shall install the Solar Mini-Grid plant and inform NEMSA and the DisCo.

2. **Inspection and Testing of the Solar Mini-Grid:** The Solar Mini-Grid developer shall apply for inspection and testing as stated in Section 3 of the Guidelines for Inspection of Solar Mini-Grids in Nigeria, 2020.

3. **Certification by NEMSA:** After the inspection, the application shall be categorized as specified in Section 4 of the Guidelines for Inspection of Solar Mini-Grids in Nigeria, 2020.

4. **Sanction and Dispute Settlement:** Sections 5 and 6 of the Guidelines for Inspection of Solar Mini-Grids in Nigeria, 2020 shall apply for any sanction for non-compliance and dispute settlement, respectively.

4.1.4 Commissioning Stage

1. The Solar Mini-Grid developer shall notify the DisCo of the commissioning date to ensure that the Point of Common Coupling with the distribution network is safe for connection.

2. The Solar Mini-Grid developer shall proceed with commissioning the plant after being issued the NERC Mini-grid Permit and NEMSA Inspection Certificate.

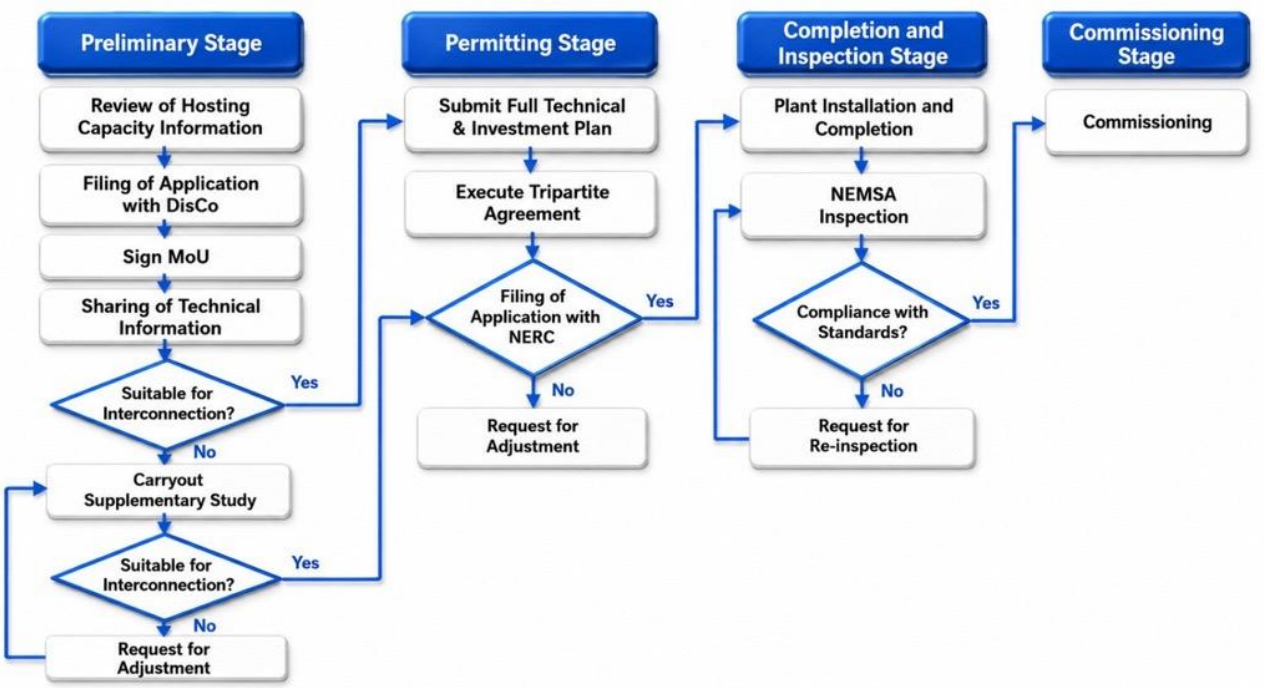

Figure 6: Interconnection Process for a Solar Mini-Grid

5 Technical Guidelines and Requirements

5.1 Technical Guidelines for Connecting as a Small Power Producer (SPP)

For a Solar Mini-Grid to operate as an SPP exporting electricity into the Distribution Network, it shall be treated as a Limited Export Interconnected Project or Managed Export Interconnected Project; it must meet the following requirements:

5.1.1 Safe Operations of SPP Facility

1. The Solar Mini-Grid shall have the following functionality parameters:
    a) Voltage regulation and power factor regulation.
    b) Low Voltage Ride-Through (LVRT) or Fault Ride-Through (FRT).
    c) Operator-control of power ramp rates and/or curtailing of power output (if desired by the DisCo).
    d) Export control functionality consistent with the approved export limit or managed export instruction.
2. For a formerly isolated Solar Mini-Grid to interconnect as an SPP, the Solar Mini-Grid inverter must be changed from an off-grid inverter to a Grid-Tie Inverter.

5.1.2 Power Quality Deviation

1. The SPP shall follow the grid frequency and voltage of the distribution network at the Point of Common Coupling (PCC).
2. The SPP shall disconnect in the event that the power quality exceeds the acceptable levels and shall inform the DisCo. Values are shown below:
    a) Voltage: Nominal (33kV, 11kV, 400V, 230V) +/- 6%
    b) Frequency: Nominal 50 Hz +/- 2.5%
    c) Total Harmonic Distortion (THD): +/- 5%

5.1.3 Relay and Anti-Islanding Functionality

1. The SPP shall have the ability to disconnect if frequency, current, voltage or other electrical parameters at the Point of Common Coupling deviate significantly from the standards as stated in 5.1.2. The functionalities described above may be accomplished by the built-in capabilities of the Grid-Tie Inverter. The relay functionalities that measure these conditions and trigger disconnection must be specified and may vary depending on generator type and size.
2. The SPP generator shall have Anti-Islanding Protection in accordance with IEC 61727 standards.

5.1.4 Dispatchability

The SPP shall have the functionality of curtailing power output (Dispatchability) if desired by the DisCo.

5.2 Technical Guidelines for Connecting as Small Power Distributor (SPD)

1. For a Solar Mini-Grid to operate as a Small Power Distributor, the arrangement may generally be treated as a Non-Export Interconnected Project.
2. The Solar Mini-Grid developer shall install a step-down transformer where the Solar Mini-Grid operates in Low Voltage (LV) while the Distribution Network is supplied at Medium Voltage (MV), and shall be connected to the secondary side of the transformer.
3. The LV assets below shall be modified to conform with the Distribution Code, 2018, the Nigerian Electricity Supply and Installation Standards Regulations (NESIS), 2015, and applicable standards as required:
    a) Conductor types and sizes
    b) Safety distances and protection corridors (rights-of-way)
    c) Proper support and accessories
    d) Selection of circuit breakers to accommodate increased breaking capacities,
    e) Lightning protection
    f) Grounding practices (earthing system)
    g) Switching equipment (protection equipment)
    h) Droplines from the pole to the end-user, and
    i) Energy meters and indoor installation practices

5.3 Technical Guidelines for Connecting as Hybrid

In the case of a hybrid approach i.e., the combination of SPP and SPD, the technical guidelines in Sections 5.1 and 5.2 shall be considered.

5.4 Technical Guidelines for Time-Split Supply (TSS) Model

For a Solar Mini-Grid operating under a Time-Split Supply Model, where electricity is supplied from the Solar Mini-Grid generator and the Distribution Network at different, pre-agreed time windows, the following technical requirements shall apply:

5.4.1 Switching and Operational Control

1. The Solar Mini-Grid shall install automated or manual switching equipment capable of safely transferring supply between Solar Mini-Grid generation and the Distribution Network without compromising system stability.
2. The switching scheme shall prevent parallel operation except where explicitly agreed with the DisCo.
3. All switching operations shall follow a jointly approved supply schedule.

5.4.2 Protection Coordination

1. Protection settings, anti-islanding requirements, and interlocking measures shall ensure correct operation during supply transitions and avoid back-feeding.
2. The protection scheme shall be coordinated with the DisCo to ensure isolation during grid outages or faulted conditions.

5.4.3 Metering and Energy Accounting

1. Metering at the interconnection point shall comply with Section 5.7 and must enable separate measurement of energy imported from the grid and energy exported to customers or the Distribution Network.
2. Smart meters with time-of-use or interval measurement capability shall be used to support the agreed TSS schedule.

5.4.4 Scheduling and Communication Requirements

1. The operational schedule shall be jointly agreed by the Solar Mini-Grid developer and the DisCo and shall specify supply hours for each source.
2. The Solar Mini-Grid operator shall maintain communication capability with the DisCo for real-time operational coordination.

5.5 Interconnection Requirements for Inverters

1. The inverter for interconnection in an SPP or Hybrid model shall be a grid-tie inverter.
2. The inverter shall have functionality that ensures that the system is stable, reliable and safe in situations of over- and under-voltage, over- and under-frequency, through protection against overcurrent in both directions.
3. The inverter shall have evidence of product testing by a certifying authority.

5.6 Tests to be Conducted by NEMSA

1. NEMSA shall perform onsite tests, including but not limited to the following:
    a) Short-Circuit Current test
    b) Insulation Resistance Test
    c) Open-Circuit Voltage Test
    d) Continuity and Earth/Ground Test
    e) Transformer Excitation Test
    f) Transformer Voltage Ratio Test
2. NEMSA shall conduct type tests and routine tests of components and equipment including but not limited to the following:
    a) Temperature stability,
    b) Response to abnormal voltage,
    c) Response to abnormal frequency,

d) Synchronization,

e) Interconnection integrity,

f) Limitation of DC injection,

g) Unintentional islanding,

h) Reverse power,

i) Open phase,

j) Harmonics, and

k) Flicker

5.7 Metering at Interconnection Point

1. Metering units shall be installed at or near the interconnection point between SPP, SPD, or Hybrid assets and DisCo-owned assets.
2. Smart meters shall be used because of their ability to measure a much wider range of parameters, including current, voltage, real and reactive power and maximum demand.
3. Metering units shall be in compliance with the Metering Code V02, 2014 and the Nigerian Smart Metering Regulations, 2015.

Annex A: Application Form for Grid Interconnection Template

The form should be filled out by the Mini-Grid Developer, as applicable, signed, and submitted to the DisCo.

Section A:

Field	Details (To be Filled by Applicant)
1. Applicant Information	
Company Name	
Company Registration Number (CAC)	
Tax Identification Number (TIN)	
NEMSA Competency Certification Number	
Company Address	
Email Address	
Contact Person	Name: Position/Designation: Phone: Email:
2. Mini-grid Facility Information	
Mini-Grid Facility Name	
Mini-Grid Coordinate (Town/State)	
Mini-grid Location (Latitude, Longitude)	
Asset Owner (if different from mini-grid company)	
Installed Capacity (kWp)	
Type of Generation	☐ Solar ☐ Solar PV + Battery Storage ☐ Hybrid (Specify):
Current Status of Mini-Grid	☐ Operational ☐ Under Construction ☐ Proposed

Project Lifespan / Years in Operation	Indicate how long the mini-grid has been in operation (e.g., 3 years) OR specify if it is a new project (e.g., New or not yet operational)
3. Interconnection Details	
Proposed or Existing Point of Common Coupling (PCC)	Latitude: Longitude: Feeder Name/Code: Supplying Substation, where applicable:
Type of Interconnection	☐ Small Power Producer (SPP) ☐ Small Power Distributor (SPD) ☐ Hybrid (SPP & SPD) ☐ Time-Split Supply
Expected Point of Common Coupling (PCC) (Latitude/Longitude)	
Type of Connection	☐ Low Voltage (LV) 0.4kV ☐ Medium Voltage (MV) 11kV☐ Medium Voltage (MV) 33kV
Proposed Interconnection Capacity (kW)	

Note: The Interconnection Type Model includes:

- Small Power Producer (SPP): Indicate if the Solar Mini-Grid will generate electricity and inject it into the distribution network.
- Small Power Distributor (SPD): Specify if the Solar Mini-Grid will be decommissioned and bulk electricity will be purchased from the distribution network for retail.
- Hybrid (SPP & SPD): Mention if the Solar Mini-Grid will both generate electricity for injection into the grid and retail electricity from the grid.
- Compensation Buy-Out: Note if the Solar Mini-Grid assets will be purchased by the DisCo.

Section B:

1. Supporting Documents Checklist

Please indicate whether the following documents are attached:

- Letter of Intent *(Attached: Yes/No)*
- Draft MoU with DisCos *(Attached: Yes/No)*

- NERC Mini-grid Permit (if applicable)

2. Declaration & Authorization

By signing below, I confirm that the information provided in this application form is accurate and complete to the best of my knowledge.

Authorized Signatory Information:

- Name of Authorized Signatory: _____
- Designation: _____
- Company Name: _____
- Signature: _____
- Date: _____

Annex B: Solar Mini-Grid Technical Information Template

This table outlines the technical information that mini-grid developers are required to share with the DisCo, including system specifications, protection schemes, power quality data, interconnection point details, and compliance with relevant standards.

Technical Parameter	Details Required
1. General System Information (Where applicable)	
Installed/Proposed Capacity (kWp)	Total installed capacity of the mini-grid.
Base Load (kW)	Minimum steady-state load of the system.
Peak Load (kW)	Maximum load of the system.
Time of Peak Load	Time at which peak load occurs.
Minimum Power Factor	Specify leading/lagging power factor.
Expected Point of Common Coupling (PCC)	Geographic location and electrical connection point (Latitude/Longitude).
Hosting Capacity Information (HCI) Reference	Date of HCI reviewed: Feeder/Network segment: Available hosting capacity, where stated: Known technical limitation, where stated:
Indicative Review Pathway, subject to DisCo / Commission confirmation	☐ Short-Form System Impact Study Confirmation may apply: eligible solar PV/battery projects ≤1 MW ☐ Full System Impact Study may apply: projects >1 MW or as directed by the Commission ☐ To be determined by DisCo / Commission
2. Customer Information (where applicable)	
Number of Customers the System Can Serve (for Existing Grid)	Total number of customers the system is designed to cater to under the existing grid configuration.
Customer Base Details	Provide breakdown of customer base (e.g., residential, commercial, industrial).
Customer Metering Arrangement (for existing mini-grids)	☐ Prepaid ☐ Postpaid ☐ Hybrid
Customer Meter Technology (for existing mini-grids)	☐ Smart meter / AMI ☐ Conventional digital ☐ Other (specify)
3. Load Data (Where applicable)	
Load Profile (kW)	Hourly load profile (e.g., 24-hour cycle showing demand variations).

Technical Parameter	Details Required
Average Load (kW)	Average power consumption over a period (e.g., daily, monthly).
Seasonal Load Variations (if applicable)	Variations in demand across different seasons (summer, winter, etc.).
Load Factor (%)	Ratio of average load to peak load over a specified period.
Diversity Factor (%)	Measure of simultaneous demand compared to total possible demand.
Maximum Demand (kW)	Highest demand during peak load conditions.
Existing Site Operating Data, where applicable	Provide historical load data, outage history, generation profile, customer connection data, and any known operational constraints.
4. Generation Assets	
PV Module Technology	Type of PV module (e.g., Monocrystalline, Polycrystalline).
PV Module Efficiency	(e.g., 20%)
PV Module Model & Manufacturer	Specify model and manufacturer.
PV Module Capacity & Quantity	Total capacity and number of modules (e.g., 300 Wp × 100).
Cumulative Capacity of PV Modules (kWp)	Total power rating of installed PV modules.
PV Compliance Standards	Proof of compliance (SONCAP/MANCAP).
5. Inverter Details	
Inverter Type	Specify grid-tied, off-grid, or hybrid.
Inverter Model & Manufacturer	Details of manufacturer and model.
Inverter Quantity & Capacity	Number and capacity of inverters (e.g., 5 × 25 kW).
Reactive Power Capability	Ability to supply reactive power (kVAr).
Inverter Compliance Standards	Proof of compliance (SONCAP/MANCAP).
Maximum Current Capability (Amps)	Maximum current available for export.
6. Battery Energy Storage System	
Battery Technology	Specify type (e.g., Lithium-Ion, Lead Acid).
Battery Model & Manufacturer	Details of manufacturer and model.
Total Storage Capacity (kWh)	Energy capacity of the battery system.
Battery Bus Voltage (DC)	Nominal DC bus voltage.
Depth of Discharge (%)	Allowable maximum depth of discharge.
Battery Compliance Standards	Proof of compliance (SONCAP/MANCAP).

Technical Parameter	Details Required
7. Backup Generation (Where applicable)	
Generator Capacity (kVA)	Rated capacity of the backup generator.
Generator Model & Manufacturer	Specify generator details.
8. Power Quality Parameters	
Voltage Tolerance (%)	Allowable voltage range at PCC.
Frequency Tolerance (Hz)	Allowable frequency range.
Harmonic Distortion (%)	Total harmonic distortion (THD) for voltage and current.
Voltage Unbalance (%)	Maximum allowable phase voltage imbalance.
Rapid Voltage Changes (%)	Maximum permissible rapid voltage changes.
Fault Ride-Through (FRT) Requirements	Ability to remain connected during faults (voltage dips).
Flicker Limits	Maximum permissible flicker at the PCC, where applicable.
9. Limited Import/Export Control (Where applicable)	
Is Export Controlled? (Yes/No)	Indicate whether export is controlled.
Percentage of Installed Capacity Available for Export	Specify the percentage of the installed capacity available for export.
Multiple Control Systems Enabled? (Yes/No)	Indicate whether multiple control systems are enabled.
Method of Export Limitation	Specify method (e.g., Active Power Control, Reverse Power Protection).
Response Time of Control System (Seconds)	Specify the control system response time.
Power Control Output Limit Setting (kW)	Define the maximum export power setting.
10. Interconnection Components & Protection	
Is a Transformer Needed Between Mini-grid & PCC? (Yes/No)	Indicate if a transformer is required for interconnection.
Will the Mini-grid Developer Procure the Transformer? (Yes/No)	Indicate responsibility for transformer procurement.
Transformer Nameplate Capacity	Provide transformer capacity details (if available).
Transformer Configuration (Three-Phase/Other)	Specify the transformer configuration.
Transformer Vector Group	Specify the vector configuration of the transformer.
Transformer Fuse Specifications	Size, type, and manufacturer of fuses.

Technical Parameter	Details Required
Interconnecting Circuit Breaker Specifications	Manufacturer, type, load rating, and interruption rating.
Circuit Breaker Trip Speed (Seconds)	Specify the trip speed of the circuit breaker.
11. Protection & Metering (Where applicable)	
Protective Relay Set Points	Minimum and maximum protection setpoints.
Current Transformer Specifications	Manufacturer, type, accuracy class, and ratio.
Potential Transformer Specifications	Manufacturer, type, accuracy class, and ratio.
Interconnection Metering Arrangement	☐ Bidirectional ☐ Export-only ☐ Import-only ☐ Other (specify)
Meter Type & Accuracy Class	Specify meter type (e.g., smart meter, CT-operated, direct-connected) and accuracy class.

Annex C: Distribution Licensee Technical Information Template

This table outlines the essential technical information required for the interconnection of a mini-grid with the DisCo.

Category	Details Required
1. DisCo Information	
Name of the DisCo	The distribution company responsible for the area.
Contact Details (relevant DisCo contact person)	Name: Phone number: Email: Office address:
2. Grid Connection Point	
Feeder Name / Code	Official feeder identifier relevant to the proposed or existing PCC.
Available Voltage Level at Point of Common Coupling (PCC)	Voltage levels at the PCC (e.g., 11 kV, 33 kV).
Available Capacity at PCC	Maximum capacity available for interconnection at the PCC.
3. Load Data	
Current and Projected Load Demand	Overview of existing and anticipated electricity demand in the area.
Load Growth Projections	Analysis of expected load growth trends over the next 5–10 years.
Seasonal Load Variations	Expected demand variations across different seasons or periods (e.g., rainy season, dry season, holiday periods).
Historical Load Profiles	Hourly/daily/monthly data (up to 5 years).
Customer Categories and Inductive Load Profiling	Customer mix (residential, commercial, industrial/inductive). Indicate customers generating significant inductive loads.
4. Power Quality Parameters	
Voltage Limits & Frequency Range	Acceptable voltage variations (e.g., ±5% of nominal voltage) and frequency (e.g., 50 Hz ± 0.5 Hz).
Power Quality Information	Harmonic distortion limits, flicker, and rapid voltage changes (if available).
5. Network Stability & Protection	
Fault Levels & Short Circuit Capacity at PCC	Short-circuit current levels at the point of interconnection.

Category	Details Required
Type of Protection Scheme Employed	Protection mechanisms (e.g., overcurrent, differential, distance protection).
Known Technical Issues	Any network problems such as power quality issues, stability constraints, or capacity limitations.
6. Metering Information	
Meter Type & Accuracy Class	Specification of meters used for energy accounting (e.g., CT/PT metering, smart meters).
Installation Requirements	Guidelines on meter placement, calibration, and testing.
7. Communication Protocols (If applicable)	
SCADA or Remote Monitoring	Specifications for communication systems, remote control, and data exchange.
8. Operational Constraints (If applicable)	
Load Shedding Schedules	Information on planned load shedding programs.
Maintenance Schedules & Expected Outages	Planned maintenance activities and anticipated network downtime affecting reliability.
9. Nearby Transformer Information	
Location & Capacity of Nearest Transformers	Transformer rating (MVA) and percentage loading (peak & off-peak).
Any Planned Increase in Transformer/Line Capacity	Future upgrades planned by the DisCo, including new transformers or lines.
10. Substation & Feeder Details	
Total Capacity of Substation (MW)	Nameplate and operational capacity of the nearest substation.
Existing Aggregated Capacity of Mini-Grids in the Distribution Network (MW)	Total capacity of interconnected mini-grids.
Current Carrying Capacity of Distribution Lines	Thermal and operational limits of feeders.
11. Network Configuration & Connectivity	
Type of Network (Radial or Ring/Loop)	Configuration of the distribution network near the mini-grid.
Nominal Voltage Levels	Standard operating voltage levels of the network.
Circuit Distances	Distance of distribution lines from substation to PCC.
Route Length of the Feeder	Distance of the specific feeder serving the interconnection point.

Category	Details Required
12. Substation & Connected Sections' Load Profile	
Peak Load & Off-Peak Load (Based on Last Year's Data)	Historical peak and minimum demand data.
13. Availability & Reliability Metrics	
SAIFI (System Average Interruption Frequency Index)	Number of power interruptions per consumer per year.
SAIDI (System Average Interruption Duration Index)	Average duration of power outages per consumer per year.
14. Network Status & Future Plans	
Status of the Distribution Network	General network conditions, voltage fluctuations, and load stability.
Any Planned Network Expansion?	Future infrastructure upgrades (e.g., new lines, transformers, automation).
15. Dispatchability Information	
Rules for Dispatch & Control	Guidelines on DisCo dispatch responsibilities and coordination with the mini-grid (e.g., dispatch priorities, limits).
16. Recent Asset Audit	
Host Network Condition	Status of poles, conductors, transformers, protection equipment, earthing integrity, and metering infrastructure.

Annex D: Distribution Licensee Feedback Form

Sample Feedback Checklist/Form for Screening Process for the purpose of interconnection (To Be Filled by the DisCo Utility/Distribution Licensee)

Note: *The screening process may take up to 7 business days. The DisCo must inform the mini-grid operator of the decision regarding the screening process, including explanations for the decision, within 10 business days of receiving the application.*

Criteria	Details
1. Completeness of Application	Is the application submitted by the mini-grid operator complete? (Note: PCC should not be on a transmission line)
2. Networked Secondary System	Is the Point of Common Coupling (PCC) within a networked secondary system?
3. Power Export	Will power be exported from the mini-grid to the DisCo's utility network?
4. Radial Distribution Network Capacity	If the PCC is within a radial distribution network, does the total AC capacity (kW_{AC}) of the mini-grid exceed 15% of the line/section or substation's peak load (annual) or the available hosting capacity of the line, section, feeder, or substation, as applicable?
5. Geographical Delineation	Is the mini-grid location geographically suitable, considering proximity to existing infrastructure and environmental factors?
6. Spot/Area Distribution Network Capacity	If connected to a spot or area distribution network, does the aggregated generation capacity (kW_{AC}) exceed 50% of the network's anticipated minimum load? (Use measured data from previous year if available)
7. Hosting Capacity Information	Does the proposed interconnection align with the DisCo's published or confirmed Hosting Capacity Information, including feeder name/code, voltage level, supplying substation, indicative available capacity, energisation window, and known technical limitations?
8. Review Pathway	Does the project qualify for Short-Form System Impact Study Confirmation, or is a full System Impact Study required? State the basis for the decision.
9. Cybersecurity Measures (where applicable)	Are adequate cybersecurity protocols in place for communication systems and data exchange?
10. Inverter Features	Do inverters have Anti-Islanding Protection and grid-interconnection capabilities?
11. Fault Current Generation	Does the mini-grid's generated fault current remain below 10% of the total fault current in the line?

Criteria	Details
12. Protective Equipment Capacity	With the introduction of the mini-grid, will any existing protective equipment (fuses, circuit breakers, line reclosers) exceed 87.5% of their rated capacity?
13. Compliance with Standards	Is the mini-grid installation compliant with applicable grid code, Nigerian Industrial Standards (NIS), Nigerian Electricity Supply and Installation Standards (NESIS) Regulations, 2015, Mini-Grid Regulations, and required certifications by the developer?
14. Stability and Safety Issues	Are there any known stability, reliability, or safety issues at the expected PCC?
15. Interconnection Configuration Compatibility	Is there compatibility in interconnection configuration? (DisCo decision with comments required on compatibility to determine next steps)
16. DisCo Decision	Indicate the DisCo's decision: ☐ Acceptable as submitted ☐ Acceptable subject to conditions ☐ Requires limited reinforcement or rectification ☐ Requires Short-Form SIS Confirmation ☐ Requires full System Impact Study ☐ Rejected with written reasons

Annex E: Technical and Investment Plan

This is a guide for developers' proposals to the DisCo

This table presents a structured outline of the key sections and details required for the proposal to interconnect a mini-grid with a DisCo.

Section	Details
1. Cover Letter	Summary of the proposal.
	Statement of intent to interconnect with the utility.
2. Developer Information and Profile	Corporate Information: Legal name, CAC registration number, and ownership/governance structure.
	Track record: number of mini-grid / RE projects implemented, total installed capacity, geographies, key clients/partners.
	Technical capability: in-house engineering, Operations and Maintenance capacity, key technical partners.
3. Executive Summary	Overview of the mini-grid project.
	Summary of technical and investment plans.
4. Project Description	
	- Location and beneficiaries.
	- Mini-grid capacity (kWp/MWp).
	- Type of generation (e.g., solar, hybrid).
	- Geographical Information: Maps or GIS coordinates.
5. Interconnection Model Type	
	- Specify the interconnection model: Small Power Producer (SPP), Small Power Distributor (SPD), Hybrid (SPP & SPD), or Compensation Buy-Out.
	- Provide a justification for the chosen model based on technical, operational, and economic considerations.
6. Technical Plan	
	- Single-line diagram (SLD) of the system.
	- Generator specifications (type, capacity, voltage).
7. Power Quality Standards	
	- Compliance with utility voltage, frequency, and harmonic distortion standards.
8. Interconnection Details	
	- Proposed Point of Common Coupling (PCC).
	- Voltage level and interconnection equipment details.

Section	Details
9. Protection Systems	
	- Protective relays and settings (e.g., over/undervoltage, anti-islanding).
10. Operational Plan	
	- Energy dispatch strategy.
	- Load profile and projections.
	- Customer Information: Types of customers and their energy needs.
11. Investment Plan	
	- Cost breakdown for interconnection (equipment, installation, testing).
	- Financing strategy and timeline.
	- Tariff Structure: Outline of tariffs for electricity transactions.
12. Risk Assessment	
	- Identification of risks (technical, financial).
	- Mitigation strategies.
13. Compliance	
	- Certification of compliance with relevant standards (e.g., IEC, NERC Mini-Grid Regulation).
	- Distribution Code compliance.
14. Testing and Commissioning	
	- Plan for pre- and post-commissioning tests (e.g., synchronization, voltage checks).
15. Communication Plan	
	- Details of SCADA integration or manual communication protocols with the utility.
	- Cybersecurity Measures: Specify cybersecurity protocols for communication systems.
16. Supporting Documents	
	- Feasibility study reports.
	- Environmental and social impact assessments (if applicable).
	- Tripartite Agreement Details: Include details if applicable.
17. Safety and Emergency Procedures	
	- Safety guidelines and emergency response plans for network operations.

Section	Details
18. Environmental Considerations	- Environmental regulations (ESMP) or considerations affecting the mini-grid's operation.

Annex F: Relevant Standards and Technical Requirements

Standard	Relevant aspcts
Nigerian standards based on IEC standards[1]	▪ NIS IEC 61727: Photovoltaic (PV) systems - Characteristics of the DisCo interface ▪ NIS IEC 62116: DisCo-interconnected photovoltaic inverters - Test procedure of islanding prevention measures ▪ NIS IEC 60364-7-712: Low voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems ▪ NIS IEC 62920: Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment ▪ NIS IEC 62891: Maximum power point tracking efficiency of grid-connected photovoltaic inverters ▪ NIS IEC 61000-3-3: Electromagnetic compatibility (EMC) - Part 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 ▪ NIS IEC 61000-3-5: Electromagnetic compatibility (EMC) - Part 3-5: Limits - Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 75 A ▪ NIS IEC 61000-3-11: Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes + voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection ▪ NIS IEC 60255**:** Measuring relays and protection equipment – Requirements for protection functions, relay performance, testing, and coordination for grid-connected generating systems

[1] The Standards Organisation of Nigeria (SON) has already adopted several IEC standards related to the interconnection requirements

Standard	Relevant aspcts
Distribution code	**Frequency** ▪ Nominal frequency is 50 Hz ± 0.5% ▪ Under system stress, frequency could experience variations within the limits of 50 Hz ± 2.5% ▪ Under extreme system fault conditions, generating assets are allowed to disconnect i.e., above 50 Hz ± 2.5% **Voltage** ▪ Low Voltage (LV): 230/400 V ±6% ▪ Medium Voltage (MV): 11 kV or 33 kV ±10% **Voltage Flicker** ▪ The Flicker Severity at the Connection Point of any User shall be a maximum of 2%. **Harmonics** ▪ Total Harmonic Distortion (THD) must not exceed 5% for voltage and 8% for current at the point of connection. **Protection Systems** ▪ Must include overcurrent, earth fault, and Anti-Islanding Protection **Environmental and Documentation** ▪ Environmental Impact Assessment (EIA) is mandatory for all projects ▪ All installations require proper documentation and inspection
Nigerian Electricity Supply and Installation Standards (NESIS) Regulations, 2015	**Power Factor** ▪ The power factor must be 0.95 lagging to 0.95 leading **Earth Resistance** ▪ Earth resistance should be ≤2 Ohms **Phase-Earth Clearance Distance** ▪ LV: ≥ 5.5 meters (over roads), ≥ 4.5 meters (over footpaths) ▪ MV: ≥ 6.1 meters (over roads), ≥ 5.2 meters (over footpaths)

Standard	Relevant aspcts
Metering Code V02, 2014	**Meter Accuracy** ▪ Distribution Metering Class 1.0 for main meters, Class 2.0 for check meters **Standards Compliance** ▪ IEC 62052/62053/62056 **Measurement Transformers** ▪ Current Transformers: Class 0.2S, 0.5, or 1.0 ▪ Voltage Transformers: Class 0.2 or 0.5 **Voltage and Current Ranges** ▪ Voltage: LV Meters (230/400 V), MV Meters (11 kV, 33 kV) ▪ Current: Direct-connected meters (Typically up to 100 A), CT-operated meters (1 A or 5 A secondary) **Frequency** ▪ Nominal: 50 Hz, ▪ Permissible range: ±2% **Environmental and Operational Ranges** ▪ Operating temperature: -10°C to +55°C for static/electronic meters ▪ Relative humidity: Up to 95% non-condensing

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