



**NIGERIAN ELECTRICITY MANAGEMENT  
SERVICES AGENCY (NEMSA)**



**GUIDELINES FOR INSPECTION OF  
SOLAR MINI-GRIDS  
IN NIGERIA**



NIGERIAN ELECTRICITY MANAGEMENT SERVICES AGENCY



# **GUIDELINES FOR THE INSPECTION OF SOLAR MINI-GRIDS IN NIGERIA**

**Date of Publication  
August, 2020**

**Published by:**

Nigerian Electricity Management Services Agency

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**ISBN: 978-978-983-567-6**

**Date of Publication:**

August 2020

This publication was produced with the financial assistance of the European Union and the German Government through the Nigerian Energy Support Programme (NESP). The views expressed herein can in no way be taken to reflect the official opinions of the European Union and the German Government.

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**NESP is co-funded by the European Union & the German Government**



## Preface

The Nigerian Electricity Management Services Agency (NEMSA) was established by the NEMSA Act, 2015, to carry out the functions of Enforcement of Technical Standards and Regulations, Technical Inspection, Testing and Certification of all categories of Electrical Installations, Electricity Meters and Instruments etc. to ensure the efficient production and delivery of safe, reliable and sustainable electricity power supply and guarantee safety of lives and property in the Nigerian Electricity Supply Industry (NESI), other allied industries and premises.

Solar mini-grids are increasingly recognized as a key solution to increase electricity access in a timely and sustainable manner. The Guidelines for Inspection of Solar Mini-grids is a publication of NEMSA developed with technical support from the Nigerian Energy Support Programme (NESP) co-funded by the European Union (EU) and the German Government and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in collaboration with the Federal Ministry of Power (FMP). The Guidelines outline the application, inspection and certification procedures/processes and documentation of Solar Mini-grids in Nigeria to achieve standardization and unification, and, ultimately, the safety of the system.

These Guidelines were developed and produced in line with National and International Law, Technical Standards, Regulations, Codes and Specifications and best electrical installations and construction practices. These include, but are not limited to: The NEMSA Act, 2015; The applicable International Electrotechnical Commission (IEC) standards; The Nigerian Electricity Health and Safety Code, 2014; The Nigerian Electricity Supply and Installation Standards (NESIS) Regulation, 2015; The Nigerian Electricity Smart Metering Regulations, 2015; The Grid Code, 2018; The Distribution Code, 2014; The Metering Code (V02), 2014; The Mini-Grid Regulations, 2016, The Electrical Installations Regulations S.I.5 and Electricity Supply Regulations S.I.6, 1996 etc.

The enforcement of Technical Standards and Technical Regulations aims to ensure a safe and reliable operation of the Solar Mini-grid System. This is achieved by ensuring that the System, including all its components, is correctly designed, specified, installed, inspected and certified to supply power to residential, commercial, industrial and institutional users in a safe manner in conformity with the applicable Technical Standards and Technical Regulations.

These Guidelines, therefore, fill a technical gap in the enforcement of Technical Standards and Technical Regulations in the Solar Mini-grid space.

## 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 Inspection of Solar Mini-grids in Nigeria, 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) in collaboration with the Federal Ministry of Power.



**Engr. Peter O. Ewesor**  
*Chief Electrical Inspector of the Federation*

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## Acronyms

AC	Alternating Current
BoS	Balance of System
C	Current
CEIF	Chief Electrical Inspector of the Federation
DC	Direct Current
FMP	Federal Ministry of Power
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IEC	International Electro-technical Commission
kV	Kilo-Volt: 1,000 Volts
KW	Kilo-Watts
KWH	Kilo-Watt-Hour
kVA	Kilo-Volt-Ampere
MD	Minor Deviation
MD/CEO	Managing Director/Chief Executive Officer
MPPT	Maximum Power Point Tracking
MW	Mega-Watts
NEMSA	Nigerian Electricity Management Services Agency
NERC	Nigerian Electricity Regulatory Commission
NESI	Nigeria Electricity Supply Industry
NESIS	Nigeria Electricity Supply and Installation Standards
NESP	Nigerian Energy Support Programme
PV	PhotoVoltaic
SLD	Single Line Diagram
V	Volt(s)
SON	Standards Organisation of Nigeria
SR	Safety Relevant

## 1 Definitions

Applicant	shall mean the Mini-grid Owner, also referred to as Owner in these Guidelines, who may authorise a third-party that is fully familiar with the Mini-Grid, to apply and procure the Inspection Certificate on its behalf, provided that he is a NEMSA certified Renewable Energy contractor for Electricity Generation.
Back-up Generation	shall mean any firm Generation such as diesel- or biomass-powered-generator that can operate within seconds of the non-availability of the Solar Photovoltaic (PV) Generation.
Balance of System (BoS)	shall mean and encompass all components of a PV system other than the PV panels; including wiring, switches, a mounting system, one or many solar inverters, a battery bank or many battery banks, related electronic battery converters and battery chargers.
Customer	shall mean and include a client of the Owner buying electricity from the Mini-Grid under a domestic, commercial, productive and/or administrative service contract, and may be a natural person or any other legal entity.
Commissioning	shall mean the period when all installations for the Mini-grid have been completed and technically inspected, tested and certified by NEMSA before the mini-grid can start Operations.
Commissioning Report	shall comprise all forms, duly completed, and accompanying information as required by the present Guidelines as well as all other applicable Laws, Regulations and Standards.
Distribution Network	shall mean electric power lines with connections for low voltage (230/400V) and optionally medium voltage (up to 33kV), transformers and other switchgear to distribute electric power produced by the Generation as well as Meters in the Mini-Grid to the Customers.
Electrical Installation	means the construction or installation of electrical wiring and the permanent attachment or installation of electrical products in or on any structure.
Electrical Safety	means any safety precautions (organisational measures and technical) taken against electricity (electric current, electric arc, electromagnetic field and static electricity) to prevent harmful and dangerous effects on anyone.

Guidelines	Shall mean these Guidelines for the Technical Inspection of Solar Mini-Grids in Nigeria, as issued by NEMSA.
Generation	shall mean the Solar PV Generation in combination with any Other Generation and Back-up Generation, as well as the land (including the Powerhouse and the Fencing) where the Generation is installed.
Inspection	shall mean the physical inspection and testing of the Owner's Solar Hybrid Mini-grid Electrical Installation by NEMSA inspectors as per the procedure described in these Guidelines.
Inspection Certificate	shall mean the Certificate issued by NEMSA to any Owner of a Solar Hybrid Mini-grid having successfully undergone the process of Inspection by NEMSA Inspectors, as defined in these Guidelines, and being valid for a period of 5 years, unless the Electrical Installation requires Significant Modifications prior to this period, in which case the Owner shall apply for Re-inspection.
Inspection Fee	shall be the fee stipulated for the purpose of inspection of Mini-Grid as published by NEMSA on <a href="http://www.nemsa.gov.ng">www.nemsa.gov.ng</a> .
Law	shall mean NEMSA Act, 2015, and any Act as approved by the Federal or State legislatures in Nigeria.
Meter	shall have the meaning given to it in the Nigerian Electricity Regulatory Commission (NERC), Metering Code, V02, NEMSA Act, 2015.
Mini-grid	shall mean "any electricity supply system with its own power Generation capacity of up to 1 MW, supplying electricity to more than one customer and which can operate in isolation from or be connected to a Distribution Licensee's network", in accordance with NERC's, Mini-grid Regulations, 2016.
Mini-grid Documentation and Inspection Forms	shall mean the standardized document to be filled by the Applicant to apply for Inspection annexed to these Guidelines, which shall be subject to changes by NEMSA and for which the latest version can be downloaded from <a href="http://www.nemsa.gov.ng">www.nemsa.gov.ng</a> or picked up in any of the NEMSA Inspectorate Field Offices ( <a href="https://nemsa.gov.ng/field-inspectorate-offices/">https://nemsa.gov.ng/field-inspectorate-offices/</a> ).
NEMSA Certified Contractor	shall mean any Renewable Energy Contractor duly certified by NEMSA to carry out Renewable Energy projects such as solar, biomass, wind etc.

NEMSA Inspector	shall mean an inspecting Engineer holding such office under NEMSA to carry out the functions of inspection, testing and certification of all electrical installation as stated in this Guidelines.
NEMSA Inspectorate Field Office	shall mean any of NEMSA's field offices located in any of the geo-political zones in Nigeria or as may be established from time to time and published on NEMSA's website.
Operating Procedures	shall mean written internal instructions of the Mini-Grid Owner to its technical and administrative staff on how to operate the Mini-grid (including to connect and service Customers), which shall comprise of procedures on personal safety, fire prevention, environmental protection and emergency shutdown, general conditions and procedures of public relevance, prices and service conditions for the Customers, a copy of the latest edition of the Inspection Certificate, where applicable, contact telephone numbers and contact details for electronic communication, and that shall be publicly displayed and accessible to Customers at the Mini-grid Powerhouse.
Operations	shall be the period starting when the Mini-grid commences its commercial activities by providing electricity services to Customers in exchange for a fee.
Other Generation	shall mean any Generation that is not Solar PV or Back-up Generation such as wind or biomass that can produce electricity in combination with the above-referred types of Generation in the Mini-grid.
Owner	shall mean any company registered and owning Mini-grids in Nigeria, as per NERC, Mini-Grid Regulations, 2016.
Provisional Inspection Certificate	shall mean an Inspection Certificate giving permission to start Servicing Customers with electricity for a period limited to 30 days before the Owner obtains the Inspection Certificate.
Regulation	shall mean any applicable piece of Regulation, as approved by the NERC or any other statutory regulatory body in Nigeria.
Re-inspection	shall mean Inspection after correcting the defects observed during Inspection or upon expiry of the Inspection Certificate for reasons of renewal of the Inspection Certificate or upon Significant Modifications carried out by the Mini-Grid Owner, and shall follow the same procedure as Inspections.

Servicing	shall mean the sale of electricity by a Mini-Grid Owner to Customers.
Significant Modifications	<p>shall mean any Modification requiring a Re-inspection</p> <ol style="list-style-type: none"> <li>1. including the following or comparable Modifications:           <ol style="list-style-type: none"> <li>a. Relocation of the Generation to a different location in the distribution network;</li> <li>b. Change of the overall System Controller or Balance of System (BoS); and</li> <li>c. any other modification that requires an approval under the Applicant's Mini-Grid Permit</li> </ol> </li> <li>2. excluding any of the following or comparable Modifications:           <ol style="list-style-type: none"> <li>a. Extension of any existing power line by no more than 3 utility poles to connect new Customers;</li> <li>b. Extension of the existing Solar PV Generation capacity, up to maximum of 30%, that does not require replacement of equipment and supply cables;</li> <li>c. Replacement of the existing Back-up Generation of same or maximum 30% larger rated power;</li> <li>d. Replacement of the existing Storage and extension by added parallel battery banks or parallel Storage systems;</li> </ol> </li> </ol> <p>All above exempted modifications are subject to notification to NEMSA for record purposes.</p>
Solar Hybrid Mini-grid	shall mean any Mini-grid that combines Solar PV Generation, Other Generation, Back-up Generation and a Distribution Network, as per NERC, Mini-grid Regulations, 2016, and the Glossary of the present Guidelines.
Solar PV Generation	shall mean the main Generation source of the Solar Hybrid Mini-grid and comprising the solar modules, the ground/roof mounted or building integrated support structure, the charge controller or grid-tie inverter and the required Balance of Systems (BoS), if not part of the System Controller.
Standard	shall mean any Standard as recommended by NERC, NEMSA and/or approved by SON or the International Electro-technical Commission (IEC).

Storage	shall mean secondary (rechargeable) batteries, including, but not necessarily limited to lead-acid batteries and lithium to store excess electricity produced by the Generation for later use, including power electronic converters or charge controllers and monitoring, if not part of the overall System Controller.
System Controller	shall mean the central element of the Generation to manage all types of Generation and Storage of the Mini-grid to ensure reliable supply of electricity to the Distribution Network of the Mini-Grid, and shall comprise of a simple charge controller for small systems (i.e. up to 10kW) and of dedicated off-grid inverters or a supervisory controller in combination with dedicated controllers and electronic power inverters for large systems (i.e. from 10kW), including all required BoS.
Technical Committee	shall mean committee put in place by NEMSA to review the complaints from Applicants, in line with Part 5 Section 14 (5) of the NEMSA Act, 2015.
Technical Documentation	shall mean data sheets, Single Line Diagrams (SLDs), detailed schematics, construction plans, internal test and Commissioning reports/protocols as well as Operating Procedures by the Mini-Grid Owners.

## 2 Scope

1. The present Guidelines describe the process and standards to be followed by the Owner (Applicant) of a Solar Hybrid Mini-grid while applying for Inspection or Re-Inspection and by NEMSA while Inspecting or Re-Inspecting Solar Hybrid Mini-grids.
2. The Inspection of Solar Hybrid Mini-grids by NEMSA shall be made in close consultation with the Applicant who shall endeavour to grant full collaboration to NEMSA; which, in turn, shall ensure a timely issuance of the Inspection Certificate in observance with the applicable Laws, Regulations and Standards.
3. The Guidelines shall be read and implemented together with other Laws, Regulations and Standards in the following order:
  - a. Laws of the Federal Republic of Nigeria, including but not limited to the NEMSA Act, 2015.
  - b. Regulations from NERC, including but not limited to:
    - i. The Nigerian Electricity Health and Safety Code, 2014.
    - ii. The Nigerian Electricity Supply and Installation Standards Regulation, 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, 2016
  - viii. Electrical Installations Regulations S.I.5 and Electricity Supply Regulations S.I.6 of 1996; and
  - ix. Other technical regulations, guidelines and codes issued by NERC or NEMSA from time to time.
- c. Guidelines as developed by NEMSA and other institutions and bodies in Nigeria, which are in line with extant laws and regulations, including but not limited to:
- i. These Guidelines; and
  - ii. The Nigerian Electrical Installations and Construction Guidelines Manual, Distribution Subsector, Volume 1, 2020.
- d. Standards of the International Electro-Technical Commission (IEC), especially for technologies that are not covered under any Nigerian Law, Regulation or Standard, 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 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 the Technical Inspection of Solar Mini-Grids as long as it is in line with the extant Regulation.
5. The Guidelines shall be subject to a review by NEMSA every five (5) years.

### 3 Process

#### 3.1 Requirement for an Inspection Certificate

Pursuant to the provisions of these Guidelines, an Inspection Certificate shall be required in either of the following circumstances:

1. Prior to Operations, the Owner of any Electrical Installation shall apply for Inspection by NEMSA and shall be entitled to an Inspection Certificate upon completion of Satisfactory Inspection.
2. Three (3) months before the expiry of the Inspection Certificate or immediately upon the completion of Significant Modifications, the Owner of an Electrical Installation shall apply for Re-inspection by NEMSA for the purpose of renewing the Inspection Certificate.

#### 3.2 Application

1. The Applicant shall apply for Inspection no later than one (1) month prior to Commissioning or with respect to Re-inspection, shall apply for Re-inspection after five (5) working days of the issuance of the Provisional Inspection Certificate by NEMSA or upon the completion of Significant Modifications.
2. Upon the completion of the construction phase of the Solar Hybrid Mini-Grid, the Applicant shall fill in the Sections of the Mini-grid Documentation and Inspection Forms that require the Applicant's action as per the table below and submit them along the Technical Documentation electronically or to the respective NEMSA Inspectorate Field Office to request for an Inspection.

Form	Title	Remarks
A	General Form	To be filled in by the Applicant
B	PV Generator	Includes 'Applicant Section'
C	Battery storage	Includes 'Applicant Section'
D	System Controller	Includes 'Applicant Section'
E	Earthing and Surge Protection System	Includes 'Applicant Section'
F	General Security	Includes 'Applicant Section'

3. NEMSA shall validate the Mini-grid Documentation and Inspection Forms and any accompanying Technical Documentation within a period of five (5) working days. Where the documentation is not valid or incomplete, NEMSA shall request for rectification, and the Applicant shall submit the rectified and/or complete documentation within a period of five (5) working days.
4. Upon validation, NEMSA shall also issue a request for payment of Inspection Fee and propose a date for Inspection, and the Applicant shall pay the Inspection Fee within a period of 5 days.

5. Upon receipt of Inspection Fee, NEMSA shall communicate a suitable date for the inspection to the Applicant within five (5) working days, and the Applicant shall confirm the date NEMSA suggested before the inspection exercise.

### 3.3 Inspection

1. Once the proposed inspection date has been agreed, the designated NEMSA Inspector shall undertake an Inspection with the Applicant in accordance with these Guidelines.
2. The Mini-grid shall be fully operational at the time of the Inspection; however, no Customer shall have been connected or served yet.
3. The Applicant shall have conducted internal tests and measurements to prove the electrical safety of the complete Electrical Installation before the Inspection and to make the reports available to the NEMSA Inspectors.
4. The Technical Documentation should be submitted along with other documents for inspection to the NEMSA Inspector.
5. During the Inspection, the NEMSA Inspector shall use the Agency's relevant test equipment for the measurements and/or to ask the applicant to repeat some test for NEMSA's observations/verifications.
6. The Inspection shall comprise of the following steps:
  - a. Guided walk-around conducted by the Applicant in the community starting with the Generation, administrative offices, main power lines, point of interconnection with other mini-grids – if available, potential main Customers, etc.
  - b. Inspection of the Distribution Network, which will include, but not be limited to:
    - i. Distribution grid pole installation;
    - ii. Distribution grid wiring; and
    - iii. Street lightning (where applicable).
    - iv. Metering installation (where applicable).
  - c. Inspection of the Generation (excluding the Storage), which will include but not limited to:
    - i. PV module quality;
    - ii. PV module array foundation;
    - iii. PV array mounting structure; and
    - iv. PV array combiner box and internal wiring.
  - d. Inspection of the Storage (including battery status and inverter performance).
  - e. Inspection of Powerhouse, which will include, but not be limited to:
    - i. Internal powerhouse wiring;
    - ii. Powerhouse foundation;
    - iii. Powerhouse general condition;

- iv. Powerhouse ventilation; and
  - v. Powerhouse flooding prevention.
  - f. Inspection of the Technical Documentation (incl. Operating Procedures).
  - g. Measurements and validation of the Measurements:
    - i. The NEMSA Inspector shall repeat selected measurements already carried out by the contractor, if there is need for such, as part of the Inspection.
    - ii. Tests and measurements related to Electrical Safety shall be in accordance with the Nigerian Electricity Health and Safety Code issued by NERC and safety requirement of extant regulation, The Nigerian Electrical Installations and Construction Guidelines Manual, Distribution Subsector, Volume 1, 2020 issued by NEMSA and shall comprise, at least, of the following aspects: the earthing resistance; continuity of the equipotential bonding; and leakage current or insulation resistance.
  - h. Inspection of Owner's comprehensive occupational safety programme, including a written safety policy and an accident investigation program.
7. The Mini-grid Documentation and Inspection Forms partly filled and submitted to NEMSA by the Applicant shall be used as the basis for the Inspection.
8. Completion of the sections of the Mini-grid Documentation and Inspection Forms to be filled by the NEMSA Inspector and explanation of the preliminary results of the Inspection to the Applicant on site.
9. In the sections of the Mini-grid Documentation and Inspection Forms marked "To be filled in by NEMSA", the NEMSA Inspector may add a comment or observation from verification of the data sheets, verification of the measurements and test reports of the Applicant, own measurements, or observations in the field.
10. The Inspector shall include comments, if any, as follows:
- a. MD: Minor Deviation to be rectified without impeding the safety.
  - b. SR: Safety Relevant deviation to be rectified.
11. The NEMSA Inspector shall mark the fields using the symbols and as illustrated in the exemplary table below.
- a. X To indicate that there is an issue in this specific combination of observation and category (MD or SR)
  - b. --- To indicate that there is no issue in this specific combination of observation and category (MD or SR)

To be filled in by NEMSA		
Comment	MD	SR
Observation 1	---	X

To be filled in by NEMSA		
Comment	MD	SR
Observation 2	X	---

12. If corrections are needed, the Inspector shall sign each request for change and write down at the end of each form the number of changes requested.
13. Upon the completion of the Inspection, the Mini-grid Documentation and Inspection Forms, shall be signed by the NEMSA Inspector and countersigned by the Applicant.
14. A copy of the Mini-grid Documentation and Inspection Forms, as filled during the Inspection, shall be made available to the Applicant upon the completion of the Inspection.

### 3.4 Evaluation

1. Upon the completion of the Inspection, NEMSA shall evaluate the compliance of the Mini-grid with the existing Technical Standards and Technical Regulations for Mini-grids in Nigeria, as specified under Sections 2.3 and 2.4 of these Guidelines, based on the Mini-grid Documentation and Inspection Forms, as filled during the Inspection and the Technical Documentation provided to the NEMSA Inspector during application for inspection exercise.
2. NEMSA shall communicate the outcome of the Evaluation, no later than two (2) weeks after the Inspection.

## 4 Inspection Certificate issuance

The Application, after the Evaluation, shall be categorized as:

1. Certified: Where the Mini-grid is fully compliant with the technical standards and regulations, NEMSA shall issue an Inspection Certificate within one (1) week from the completion of the Evaluation, and the Applicant may start Servicing the Customers upon receipt of the Inspection Certificate;
2. Limited Safety Approval: Where minor non-compliance issues have been identified in the Mini-grid, NEMSA shall issue the Provisional Inspection Certificate within one (1) week from the completion of the Evaluation, upon which the Applicant may start Servicing the Customers, and shall have a period of 30 days to rectify the minor non-compliance issues communicated by NEMSA, upon such rectification and proof of the same submitted to NEMSA, an Inspection Certificate shall be issued by NEMSA within one (1) week; or
3. Rejected: Where major non-compliance issues have been identified in the Mini-grid, NEMSA shall not provide any (Provisional) Inspection Certificate and shall invite the Applicant to rectify all non-compliance issues identified during the Inspection and Evaluation for which the Mini-grid is not compliant and apply for a Re-Inspection, which shall follow the same process as Inspection set out above.

## 5 Sanction for non-compliance

After the period of 30 days, if the Applicant fails to communicate to NEMSA for the re-inspection towards certification, the Applicant's Provisional Approval will be revoked.

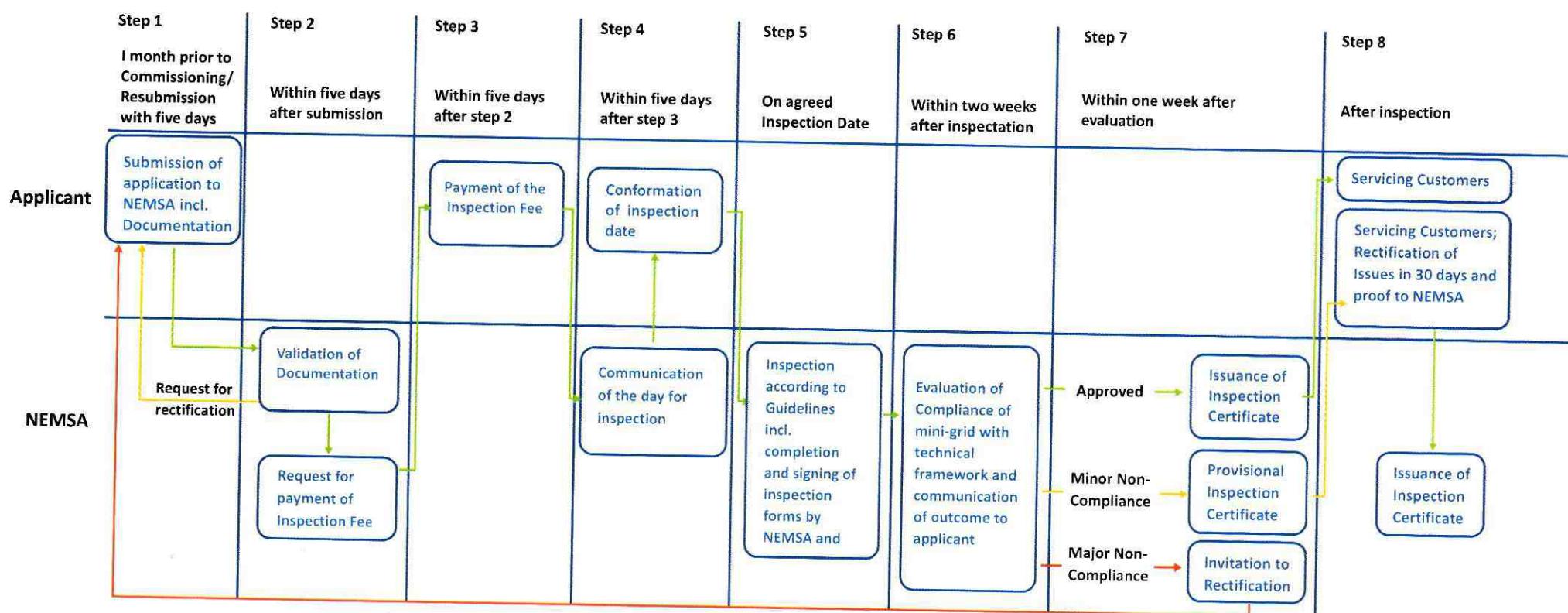
## 6 Dispute settlement

1. Where an Applicant is aggrieved by the decision or Inspection carried out by NEMSA, He/she may file a written complaint to the Technical Committee of NEMSA within a period of fifteen (15) working days from such decision or Inspection by NEMSA, including all pertinent details, dates and documents, as applicable.
2. The Technical Committee shall review and resolve the complaint and communicate the same to the Applicant within a period of fifteen (15) working days from the receipt of such complaint.
3. Where the Technical Committee fails to respond within fifteen (15) working days or the Applicant is aggrieved by the decision of the Technical Committee, the Applicant may forward the complaint to MD/CEO & CEIF for further necessary action.

## 7 Process Flow Diagram

The below process flow diagram presents the process as outlined above.

**Figure 1: Flow Diagram for the process to obtain an inspection certificate**



## **8 Annex – Mini-grid Documentation and Inspection Forms**

- General Form – A1
- General Form – A2
- PV generator – Layout and Single Line Diagram B1
- PV generator – Specification of main components B2
- PV generator – Test and verification B3
- PV generator – Test and verification B4
- Battery storage – Layout and SLD C1
- Battery storage – Specification of main components C2
- Battery storage – Test and verification C3
- Battery storage – Test and verification C4
- Battery storage – Test and verification C5
- System Controller – Layout and SLD D1
- System Controller – Specification of components D2
- Earthing and Surge Protection System E1
- Earthing and Surge Protection System E2
- General security F1

# Mini-Grid Documentation and Inspection: General Form

This form must be included in every application and duly signed on page "A2", if the Applicant is different to the Mini-Grid Owner, the Mini-Grid Owner must additionally sign

Row Line	To be filled in by the Applicant							
	A	B	C	D	E	F	G	H
	Mini-Grid Owner	Applicant (if different)		Authorized representative		Other		
1 Company name								
2 Street								
3 Further address details								
4 Town								
5 Tax registration number								
6 Name of representative								
7 Position								
8 Telephone								
9 E-mail								
Details of the Mini-Grid								
	Name of the village	Federal state	District		Number of inhabitants		GPS Coordinates	
10	Main business activity #1	Main business activity #2	Administrative facilities		Educational facilities		Health care facilities	
11	Total installed power [kVA]	Total solar PV installed [kW <sub>P</sub> ]	Storage technology		Storage capacity [kWh]		Storage manufacturer	
12	System controller model	System controller manufacturer	Charge controller manufacturer		Grid-tie inverter manufacturer		Monitoring system	
13	Other generation technology	Other manufacturer	Other model		Other rated power [kVA]		Type of coupling (AC/DC)	
14	# Generator model	Manufacturer	Generator rated power [kVA]		Operating	Year of constr.	Fuel type	Operation
15	1		Prime	Standby				
16	2		Prime	Standby				

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: General Form

*This form must be included in every application and duly signed*

Row Line	To be filled in by the Applicant				
	A	B	C	D	E
17 Single Line Diagram					
18 Data of installation		Mini-Grid Owner	Full name of signatory	Signature	
19 Date of application		Applicant (if different to Mini-Grid Owner)			
To be filled in by NEMSA					
Responsible Inspectorate Field Office	Date of receipt of application	Processed by	Date		
20					
21					
22					

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: PV generator – Layout and Single Line Diagram

B1

Applicant can replace this form by equivalent technical drawings – pages to be labelled "B1"

Row	To be filled in by the applicant								To be filled in by NEMSA	
	A	B	C	D	E	F	G	H	Comment	MD
101										
102										
103										
104										
105										
106										
107										
108										
109										
110										
<b>Site layout</b>										
<b>Single Line Diagram</b>										

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: PV generator – Specification of main components

B2

Applicant can replace this form by equivalent technical description – pages to be labelled "B2" and to attach the relevant data sheets

Row	To be filled in by the applicant								To be filled in by NEMSA									
	A	B	C	D	E	F	G	H	Comment	MD SR								
	<b>Catalogue of solar PV modules used (data sheets to be attached)</b>																	
#	Manufacturer	Model	Technology	STC power [W <sub>p</sub> ]	Nb. of cells	MPPT Current	MPPT voltage	Verify data sheets attached										
111	1																	
112	2																	
113	3																	
	<b>Catalogue of charge controllers or grid-tie inverters used (data sheets to be attached)</b>																	
#	Manufacturer	Model	Technology	Rated power	Rated voltage	Rated current		Verify data sheets attached										
114	1																	
115	2																	
116	3																	
	<b>Catalogue of string combiner boxes</b>																	
#	Model	SLD of model #1			SLD of model #2			SLD of model #3		Verify data sheets attached								
117	1									#1								
118	2																	#2
119	3																	
	<b>String references, number of strings marked in the SLD in lines 106 ... 110</b>																	
	String number	1	2	3	4	5	6	Verify if installed correctly										
120	Module catalogue #																	
121	Number Series   Parallel	S	P	S	P	S	P	S	P	S								
122	Total power [W <sub>p</sub> ]																	
123	Fuse [A]																	
124	Surge Protection Device																	
125	Converter catalogue # from lines 114 ... 116																	
126	Cable cross-section																	

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: PV generator – Test and verification

B3

Applicant can replace this form by equivalent test and verification reports according to IEC 62446 – pages to be labelled "B3". Use additional copies of this form if needed.

Row	To be filled in by the applicant (preferred) or by NEMSA inspector (optional)							To be filled in by NEMSA		
	A	B	C	D	E	F	G	Comment	MD	SR
	String references									
	String number	1	2	3	4	5	6	Verify Applicants' measurements		
127	Expected open circuit voltage [V]									
128	Measured open circuit voltage [V]									
129	Expected load circuit voltage [V]									
130	Measured load circuit voltage [V]									
131	Expected short circuit current [A]									
132	Measured short circuit current [A]									
133	Measured ambient temperature [°C]									
134	Measured module temperature [°C]									
135	Measured solar insulation [W/m <sup>2</sup> ]									
136	Alternatively, estimated insulation (cloudy, sunny, mist, ...)									
137	Expected power output [kW]									
138	Measured power output [kW]									
137	Measured insulation resistance [Mega Ohm]									
138	Measured continuity to main equipotential bar [Ohm]									
139	Measured earth resistance of support structure [Ohm]									
141	Result of verification of measured values (OK, low, ...)									

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: PV generator – Test and verification

B4

Applicant can replace this form by equivalent test and verification reports according to IEC 62446 – pages to be labelled "B4"

Row	To be filled in by the applicant (preferred) or by NEMSA inspector (optional)	String references						To be filled in by NEMSA	Comment	MD	SR
		A	B	C	D	E	F				
	String number	1	2	3	4	5	6		Verify applicant's visual inspections		
141	General visual inspection observations										
142	Surge Protective Devices functional (indicator at device)?										
143	Overcurrent protection operational (correct fuse rating)?										
144	String cables fixed and cables without damages										
145	Connectors properly connected under no mechanical strain										
146											
147											
148											
149											
150											
151											
152											
153											
154											
155											
156	Summary of the visual inspections										
157	Date of the inspection										
158	Signature										

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: Battery storage – Layout and SLD

Applicant can replace this form by equivalent technical drawings – pages to be labelled "C1". Use building layout if more than one battery storage is installed to illustrate reference to the location the battery in the building.

Row	To be filled in by the applicant								To be filled in by NEMSA	
	A	B	C	D	E	F	G	H	Comment	MD
201	Building layout									
202										
203										
204										
205										
206	Single Line Diagram									
207										
208										
209										
210										

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: Battery storage – Specification of main components C2

Applicant can replace this form by equivalent technical description – pages to be labelled "C2" and to attach the data sheets of the storage system(s)

Row	To be filled in by the applicant								To be filled in by NEMSA						
	A	B	C	D	E	F	G	H	Comment	MD	SR				
	<b>Catalogue of battery storage cells used (data sheets to be attached)</b>														
#	Manufacturer	Model	Technology	Cell voltage [V]	Battery voltage	C <sub>10</sub> capacity	Charge voltage	Verify data sheets attached							
211	1														
212	2														
213	3														
	<b>Catalogue of battery string configurations and battery monitoring details</b>														
#	Model	Battery string #1			Battery string #2			Battery string #3			Verify	data	sheets	attached	and
217	1										#1				
218	2										#2				
219	3										#3				
	<b>Battery string references, number of strings marked in the SLD in lines 206 ... 210</b>														
	String number	1	2	3	4	5	6	Verify if installed correctly							
220	Module catalogue #														
221	Number Series   Parallel	S	P	S	P	S	P	S	P	S	P				
222	Total C10 capacity [kWh]														
223	Fuse rating [A]														
224	Date of cell production or														
225	Date of installation and commissioning														
226	Cable cross-section [mm <sup>2</sup> ]														
227	General comments														

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: Battery storage – Test and verification

C3

Applicant can replace this form by equivalent test and verification reports according to IEC 62485 – pages to be labelled "C3"

Row	A	To be filled in by the applicant (preferred) or by NEMSA inspector (optional)						Comment	To be filled in by NEMSA	
		B	C	D	E	F	G		MD	SR
	String references								Verify applicant's visual inspections	
String number	1	2	3	4	5	6				
228 General visual inspection observations										
229 Wiring properly done without visual deficits										
230 Tightening torque of all screws to connectors to the batteries and in between the cells of the batteries is according to the equipment manufacturer's recommendations										
231 Battery inverter or charge controller parameters are properly set (correct system configuration, date and time, control of the load shedding relays, reading of external temperature sensor verified, ...)										
232 State of charge (If applicable state of health)										
233 Safety measures for the respective types of batteries applied										
234 Deep discharge protection, over-charge protection and temperature monitoring installed and functional										
235 Number of full cycles calculated by the monitoring system (if applicable)										
236										
237										
238										
239										
240										
241										

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: Battery storage – Test and verification

C4

Applicant can replace this form by equivalent test and verification reports – pages to be labelled "C4", use additional sheets if more cells are installed

	A	B	C	D	E	F	G	H	I	J	K	L	M	To be filled in by NEMSA	
	To be filled in by applicant												Comment	MD	SR
	Measurement of battery cell parameters for battery string #1														
<b>Cell number</b>	1	2	3	4	5	6	7	8	9	10	11	12	Verify measurements		
242 Cell voltage															
243 Cell impedance															
244 Cell temperature															
<b>Cell number</b>	13	14	15	16	17	18	19	20	21	22	23	24	Verify measurements		
245 Cell voltage															
246 Cell impedance															
247 Cell temperature															
	Measurement of battery cell parameters for battery string #2														
<b>Cell number</b>	1	2	3	4	5	6	7	8	9	10	11	12	Verify measurements		
242 Cell voltage															
243 Cell impedance															
244 Cell temperature															
<b>Cell number</b>	13	14	15	16	17	18	19	20	21	22	23	24	Verify measurements		
245 Cell voltage															
246 Cell impedance															
247 Cell temperature															

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: Battery storage – Test and verification

Applicant can replace this form by equivalent test and verification reports – pages to be labelled "C4", use additional sheets if more cells are installed

	To be filled in by applicant												To be filled in by NEMSA		
	A	B	C	D	E	F	G	H	I	J	K	L	M	Comment	MD SR
	<b>Measurement of battery cell parameters for battery string #1</b>														
<b>Cell number</b>	1	2	3	4	5	6	7	8	9	10	11	12	Verify measurements		
248 Cell voltage															
249 Cell impedance															
225 Cell temperature															
<b>Cell number</b>	13	14	15	16	17	18	19	20	21	22	23	24	Verify measurements		
251 Cell voltage															
252 Cell impedance															
253 Cell temperature															
	<b>Measurement of battery cell parameters for battery string #2</b>														
<b>Cell number</b>	1	2	3	4	5	6	7	8	9	10	11	12	Verify measurements		
254 Cell voltage															
255 Cell impedance															
256 Cell temperature															
<b>Cell number</b>	13	14	15	16	17	18	19	20	21	22	23	24	Verify measurements		
257 Cell voltage															
258 Cell impedance															
259 Cell temperature															

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: System Controller – Layout and SLD

D1

*Applicant can replace this form by equivalent technical drawings – pages to be labelled "D1". Use building layout if more than one System Controller is installed to illustrate reference to the location in the building.*

Row	To be filled in by the applicant								To be filled in by NEMSA		
	A	B	C	D	E	F	G	H	Comment	MD	SR
301	<b>Building layout</b>										
302											
303											
304											
305											
306											
307											
308											
309											
310											
	<b>Single Line Diagram</b>										

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: System Controller – Specification of components

D2

Applicant can replace this form by equivalent technical description – pages to be labelled "D2" and to attach the data sheets of the inverter(s) and charge controller(s)

Row	To be filled in by the applicant								To be filled in by NEMSA	
	A	B	C	D	E	F	G	H	Comment	MD
	Catalogue of inverters and charge controllers used (data sheets to be attached)									
#	Manufacturer	Model	Technology	Rated power	Rated voltage	Rated current	Features	Verify data sheets attached		
311	1									
312	2									
313	3									
314	4									
315	5									
316	6									

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: System Controller – Test and verification

D3

Applicant can replace this form by equivalent test and verification reports according to IEC 60364 – pages to be labelled "D3"

Row	A	To be filled in by the Applicant (preferred) or by NEMSA inspector (optional)						Comment	To be filled in by NEMSA	
		B	C	D	E	F	G		MD	SR
Reference to the inverter catalogue as per lines 311 ... 316										
Device number		1	2	3	4	5	6	Verify applicant's visual inspections		
317	General visual inspection observations									
318	Inverter protection settings programmed to local requirements?									
319	When an RCD is installed to the AC circuit feeding an inverter, the RCD type shall be verified to ensure it has been selected according to the requirements of IEC 60364									
320	Means of isolating the inverter been provided on the AC side?									
321	Isolating and switching devices been connected such that PC installation is wired to the "load" side and the public supply to									
322	All Inverters/Charge controller operating correctly?									
323	Inverter/charge controller protection settings and installer details displayed on site?									
324										
325										
326										
327										
328										
329										
330										

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: Earthing and Surge Protection System

E1

Applicant can replace this form by equivalent technical drawings – pages to be labelled “E1”. Use site layout to illustrate the earthing arrangement and earth resistances measured and use the Single Line Diagram to clarify connections to the main earthing busbar, conductor cross sections, etc.

Row	To be filled in by the Applicant								To be filled in by NEMSA		
	A	B	C	D	E	F	G	H	Comment	MD	SR
401											
402											
403											
404											
405											

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: Earthing and Surge Protection System

E2

Applicant can replace this form by equivalent technical drawings – pages to be labelled “E2”. Use site layout to illustrate the earthing arrangement and earth resistances measured and use the Single Line Diagram to clarify connections to the main earthing busbar, conductor cross sections, etc.

Row	To be filled in by the Applicant								To be filled in by NEMSA		
	A	B	C	D	E	F	G	H	Comment	MD	SR
406											
407											
408											
409											
410											

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_

# Mini-Grid Documentation and Inspection: General security

Applicant to add comments how the requirements are met or attach further documents for clarification.

Row	To be filled in by the Applicant	B	To be filled in by NEMSA	
			Comment	MD SR
501	A Fencing is installed to prevent access to the Generation			
502	Building structures are in good and stable condition			
503	Foundations are in good and stable condition			
504	Operating Procedures are displayed in public			
505	Smoke detectors are installed in the Power House			
506	Firefighting equipment is available on site, is functional and local staff is trained to use it			
507	Warning signs indicating dangers and preventing access are installed			
508	Local staff is trained in emergency shut-down and general operating procedures			
509	Internal safety procedures are displayed and understood by local staff, provide last date of the safety training			
510	Internal procedures and measures for environmental protection are implemented and trained			
511				
512				
513				

NEMSA Reference number \_\_\_\_\_ Site name \_\_\_\_\_ Date \_\_\_\_\_ Inspector name \_\_\_\_\_ Signature \_\_\_\_\_



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