**Project completion report – Solar mini-grid• Template**

Project completion report

of [Site name]

Solar mini-grid

Project title: [Title]

Project code: [Code]

Date: December 20, 2023

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| --- | --- |
| **Prepared by** | **Submitted to** |
| [Company name]  [Company address] | [Company name]  [Company address] |

List of separate attachments submitted along with this report:

1. Letter from the rural municipality (if required)
2. Equipment datasheets
3. As-built engineering drawings
4. Single-line diagram
5. Snapshots of the as-built site map (provide Google Earth .kml file separately)

Glossary

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|  |  |
|  |  |
|  |  |

Table of Contents

[1 Executive Summary 1](#_Toc152769654)

[2 Site details 1](#_Toc152769655)

[2.1 Location 1](#_Toc152769656)

[2.2 Site access 1](#_Toc152769657)

[2.3 Demography 2](#_Toc152769658)

[2.4 Security 2](#_Toc152769659)

[2.5 Telecommunications and internet access 2](#_Toc152769660)

[2.6 Climate risks during project execution 2](#_Toc152769661)

[2.7 Current status of electricity 2](#_Toc152769662)

[3 Technical details 3](#_Toc152769663)

[3.1 Solar array location 3](#_Toc152769664)

[3.2 Powerhouse location 3](#_Toc152769665)

[3.3 Site layout 3](#_Toc152769666)

[3.4 Utilization of existing infrastructure 3](#_Toc152769667)

[3.5 Energy generation 3](#_Toc152769668)

[3.6 Daily load and energy demand analysis 4](#_Toc152769669)

[3.6.1 System architecture 4](#_Toc152769670)

[3.7 As-built single-line diagram 4](#_Toc152769671)

[3.8 Shading analysis 4](#_Toc152769672)

[3.8.1 Near and far shading 4](#_Toc152769673)

[3.9 Solar PV array 4](#_Toc152769674)

[3.10 Module mounting structure 4](#_Toc152769675)

[3.11 On-grid inverter(s) 4](#_Toc152769676)

[3.12 Battery inverter(s) 4](#_Toc152769677)

[3.13 Battery bank 5](#_Toc152769678)

[3.14 Powerhouse and fencing 5](#_Toc152769679)

[3.15 Transmission and distribution 5](#_Toc152769680)

[3.16 Metering 5](#_Toc152769681)

[3.17 Cables 5](#_Toc152769682)

[3.18 Protection equipment (MCBs, SPDs, AC/DC combiner boxes, etc.) 5](#_Toc152769683)

[3.18.1 Cable route details 6](#_Toc152769684)

[3.18.2 Lightning arrestors 6](#_Toc152769685)

[3.18.3 Earthing 6](#_Toc152769686)

[4 Safety considerations 6](#_Toc152769687)

[5 Bill of quantity (as-built) 6](#_Toc152769688)

[6 Electricity tariff 6](#_Toc152769689)

[7 Community perspective 7](#_Toc152769690)

[8 Conclusion 7](#_Toc152769691)

[9 AnnexES 7](#_Toc152769692)

[9.1 Letter from the rural municipality (if required) 7](#_Toc152769693)

[9.2 Photos 7](#_Toc152769694)

[9.3 Equipment datasheets 8](#_Toc152769695)

[9.4 As-built engineering drawings 8](#_Toc152769696)

[9.5 Single Line Diagram 8](#_Toc152769697)

[9.6 Snapshots of the as-built site map 8](#_Toc152769698)

# Executive Summary

*Describe briefly in* ***one page*** *the key features of the project.*

*Paragraph #1*

1. *Site location*
2. *The actual number of households, private and public institutions, and enterprises*
3. *Date when the testing and commissioning were completed*

*Paragraph #2*

1. *Current load and energy demand*

*Paragraph #3*

1. *The coverage area of the solar mini-grid (ward numbers, area in sq. km)*
2. *System description (solar array capacity, on-grid and battery inverter capacity, battery bank capacity)*
3. *Annual energy production as per design*

*Paragraph #5*

1. *Major project risks and mitigations*
2. *Conclusion*

# Site details

## Location

*Describe the location of the site and provide information about,*

1. *Site address (ward number, rural municipality, district and province)*
2. *Site coordinates*
3. *User committee information (registered/non-registered, number of members, details of user committee chair)*

*Figure suggestions*

1. *Bird’s eye view of the site with boundary marking*

## Site access

*Describe the accessibility of the site. Provide information about,*

1. *Access route description (vehicle access, type of road/path e.g., earthen, gravel, black-topped*
2. *Observations of population density in the site area (for example, dense households, sparsely populated, etc.)*

*Photo suggestions*

1. *Bird’s eye view of the site location within a few hundred meters of ground elevation*
2. *Bird’s eye view of the site location showing pinned site location and the nearest city*
3. *Access road/path*

## Demography

*Describe the demography of the site area. Provide information about,*

1. *Population*
2. *Number of households, private and public institutions*
3. *Household and institutions distribution by ‘toles’ or wards*
4. *Types of the population (ethnicity-wise)*
5. *Income sources of community and average monthly expenditure for lighting purpose*

*Photo suggestions*

1. *Institutions/existing milling, grinding industry etc. power-intensive appliances*
2. *Google Earth photo locating the proposed settlements for electrification*

## Security

*Describe the security aspects of the site area from the perspective of solar mini-grid system. Provide information about,*

1. *Security of solar array location*
2. *Security of powerhouse location*
3. *Security for household energy metering*

*Photo suggestions*

1. *North, South, East and West view of solar array location*
2. *North, South, East and West view of powerhouse location*

## Telecommunications and internet access

*Describe coverage of mobile network and internet access. Provide information about,*

1. *Best mobile carrier name and internet service provider*
2. *Type of mobile data connection (for example: calls only, 2G only, 3G only, 4G, etc.)*
3. *Reliability of mobile network*
4. *Nearest facility with internet access (for example, ward office, rural municipality office) and its distance from the powerhouse*

## Climate risks during project execution

*Provide information about site observations during project construction about extremities in climate and weather- conditions like flooding, landslide, lightning, etc. that concern the solar mini-grid.*

## Current status of electricity

*During the construction of the project, other sources of electricity within the vicinity of the solar mini-grid may have been planned. Describe the current status of household electricity sources on the site. Provide information about,*

1. *Future plans, data, and information on grid electricity access collected via NEA, or LG/PG*
2. *Remarks on any planned electrification projects (for example: micro-hydro power plant) near the solar mini-grid*
3. *Previous means of household electricity sources prior to solar mini-grid electricity (for example, solar home systems, diesel generators, kerosene, Jharo, etc.)*
4. *Nearest location with grid electricity access and its distance from the site*
5. *Nearest location of other mini-grid plants (for example, micro-hydro power plant) to look for the possibility of interconnection in the future*

# Technical details

## Solar array location

1. *Must include the land area, ownership details, GPS coordinates, topography, as-built orientation and azimuth, near and far shading, slope and soil type, wind loading, etc.*
2. *Details of usability with respect to natural calamities such as floods, landslides, lightning, etc.*
3. *Details related to safety from humans, such as fencing*

*Photo suggestions*

*Bird’s eye view of solar array location with boundary markings*

## Powerhouse location

1. *Must include the land area, ownership details, GPS coordinates, topography, slope and soil type, etc.*
2. *Details of usability with respect to natural calamities such as floods, landslides, lightning, etc.*
3. *Details related to safety from humans, such as fencing*

*Photo suggestions*

*Bird’s eye view of powerhouse location with boundary markings*

## Site layout

1. *Overall project map layout using CAD inclusive of PV array, powerhouse, HHs, PEUs, T&D, etc.*
2. *Measurements of data related to the size, topography, terrain, soil condition, etc. and plotting them using CAD or similar software*

## Utilization of existing infrastructure

*Describe any existing (pre-built) infrastructure that the SMG utilized during construction. For example, existing power poles, powerhouse, etc.*

## Energy generation

*Present the designed energy generation as per the detailed feasibility study. Use graphical representation to present GHI, losses, monthly energy generation profiles, etc. as per the detailed feasibility study.*

## Daily load and energy demand analysis

*Describe, calculate and show in tables and graphs the measured daily load analysis for 72 hours (including a weekend) and present an analysis showing the relationship between the obtained data and the initial design estimations (for example, peak load is X% of the system capacity, daily average depth-of-discharge of the battery bank, etc.)*

### System architecture

*Present a block diagram and describe the system architecture (for example, AC-coupled, DC-coupled, etc.).*

## As-built single-line diagram

1. *Include labelling of the project name, system size, cable sizes, and all the component sizes including MCBs, SPDs etc. along with the legend*
2. *Must show the array, inverter, battery bank, switchgear configuration, etc.*
3. *Each component used in the SLD must be recognized well despite its size, and the quality and printing layout must be maintained for A3-size paper*

## Shading analysis

### Near and far shading

1. *Mention the criteria, formula, tools, etc. used in determining the shading analysis.*
2. *Shading analysis of the solar array over 12 months with December 22nd data in focus, simulations (if needed).*
3. *Each row of the proposed array should have its shading analysis done and projected*

## Solar PV array

1. *Modules specifications*
2. *The sizing, design, distribution, and positioning of solar PV array*
3. *Sizing, design and placement of combiner boxes, relevant accessories, power evacuation channels, earth points, etc.*

## Module mounting structure

1. *Must include an as-built drawing of the module mounting structure*
2. *Calculations related to wind loading requirements, civil foundation details, size of vertical legs, purlins, braces and struts, rafters, base plates, joints, mid-clamps, end clams, etc. must be presented*
3. *Type of material proposed, its strength, advantage, selection procedure and other technical parameters and specifications must be mentioned*

## On-grid inverter(s)

1. *Must include key specifications and related compatibility with other components primarily array configurations and generation-side DC components*

## Battery inverter(s)

1. *Must include key specifications and related compatibility with other components primarily battery bank and DC components*

## Battery bank

1. *Must include key specifications, days of autonomy, parallel paths, etc.*
2. *Must present the total surface area occupied in the powerhouse, and if it’s a vertical stacking, provide details of the racking height*

## Powerhouse and fencing

1. *Must include the as-built drawings, specification, and civil components description including fencing*
2. *Must include plan and side views showing placements of installed equipment*
3. *Must include details regarding construction materials, structure analysis, PCC, roofing, doors and windows with proper ventilation, foundation etc. meeting statutory regulations, standards and requirements for civil construction, design, and drawings*

## Transmission and distribution

1. *Must include a table with a summary of design, lengths, conductors used, accessories used, poles, insulators, lightning arrestors, transformer capacity and specification wherever necessary, etc.*
2. *As-built T&D details with a calculation sheet of voltage drops must be provided in the annexes*
3. *Cable type details – ACSR, ABC or other types must be mentioned*
4. *T&D will be accompanied by drawings and layout fit for A3 size paper indicating load centres, powerhouse, PEUs, public buildings, pole erection guidelines, specification of components used, etc.*

## Metering

1. *Provide details of the energy meter at the output of the ACDB*
2. *Detailed specification and consumer-side energy meters (for example, pre/postpaid, current ratings, etc.)*
3. *Provide details of the consumer-side energy meter used. For example, Type 1: for HH, Type 2: for PEU, Type 3: Others.*
4. *Briefly describe the features of consumer-side meters such as step tariffs, recharging system (for pre-paid energy meters), etc.*

## Cables

1. *Details of as-built cable types and sizes used for different sections. For example, UV cable for outdoors, flexible multistrand cables for the DC side, XLPE for AC output, etc.*
2. *The type of cables e.g., single core, three core, etc. must be mentioned and a chart of cables used in the SMG must be presented*
3. *AC, DC, and communication cables must be distinguished and labelled well in the SLD*

## Protection equipment (MCBs, SPDs, AC/DC combiner boxes, etc.)

1. *Specification including the class, type, etc of different MCBs for each string (string breakers), dc MCBs for DC side, ac MCBs for AC side, SPDs and MCCB on the output must be mentioned*
2. *Specifications of AC/DC combiner boxes must be mentioned*

### Cable route details

1. *The cable route must be shown* *in the overall electrical layout diagram to and from the array and the powerhouse. This cable routing plan is different from the T&D line*

### Lightning arrestors

1. *Location(s) and specifications (including type and ratings) of lightning arrestors must be mentioned*
2. *All the accessories used in LA including the down conductor, pole, etc. must be mentioned*

### Earthing

1. *Total number of earthing and their location must be mentioned*
2. *Specifications of earthing pits including materials used during installation must be mentioned (for example, earthing rod material, the chemical used, etc.)*
3. *Earth resistance of each earthing point must be given*

# Safety considerations

1. *Measures that must be taken for the safety of SMG including PV array, powerhouse, transmission, and distribution centres, etc. must be mentioned*
2. *Precautions and measures operation and management authority, safe handling of SMG components and safe use of appliances must be mentioned*
3. *Other safety measures that must be observed on-site must be mentioned*

# Bill of quantity (as-built)

*Provide a table with a list of detailed BoQ as per the design/bidding document. The table below is given as a reference.*

|  |  |  |  |
| --- | --- | --- | --- |
| **SN** | **Item** | **Quantity (as per bidding document)** | **Quantity (as-built)** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# Electricity tariff

1. *If within the scope of the contract, provide details of the SMG electricity tariff agreed upon by the community and how it was determined*
2. *Describe the tariff collection mechanism ensuring its reliable and transparent collection and management*

# Community perspective

*Describe the observations made about the community during the construction. Provide information about,*

1. *Awareness of the users about solar mini-grid systems (for example, seeing no difference between grid electricity and solar mini-grid electricity from the user’s perspective, understanding that the community can confidently rely on solar mini-grid electricity, etc.)*
2. *Willingness to pay, understanding of tariff mechanism*
3. *Social cohesion or divisions within the community, social and political conditions, etc.*
4. *Possibility of new PEUs after installation of SMG*
5. *Any social concerns regarding the solar mini-grid project*

*Local/Provincial government perspective*

1. *Ownership of the project for sustainable and smooth operation*

# Conclusion

*Provide a summary of the SMG architecture, construction completion dates, major risks and mitigations, any recommendations for operation and management, etc.*

# AnnexES

## Letter from the rural municipality (if required)

*Attach a letter from the rural municipality confirming the completion of the project.*

## Photos

*At least, include photos of,*

1. *Solar array*
2. *Powerhouse*
3. *Inverters*
4. *Battery bank*
5. *Combiner and distribution boxes*
6. *Earthing pits with visible connection points*
7. *Few photos of T&D (visible pole, cable path, insulators, lightning arresters)*
8. *Consumer-side energy meter*

## Equipment datasheets

## As-built engineering drawings

## Single line diagram

## Snapshots of the as-built site map

1. *Provide snapshots of the site map demarcating locations of the solar array, powerhouse, and the T&D path*
2. *Provide a Google Earth .kml file separately*