## **Installation and commissioning checklist – Solar grid-connected system • Template**

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| Commissioning engineer information | |
| Name: |  |
| Email: |  |
| Phone number: |  |
| Signature: |  |

|  |  |
| --- | --- |
| Project stakeholders | |
| Design |  |
| Engineering |  |
| Installation |  |
| Post-installation check |  |
| Maintenance |  |
| Other |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Key recommendations | | | | |
| SN | **Components affected** | **Recommendation** | **Priority level** | **Assigned to** |
| 1. |  |  |  |  |
| 2. |  |  |  |  |
| 3. |  |  |  |  |
| 4. |  |  |  |  |
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| --- | --- |
| Customer information | |
| Contact name: |  |
| Address: |  |
| Phone number: |  |
| Email: |  |

**Installation and commissioning information**

|  |  |
| --- | --- |
| Date of commissioning: | ……………………………………………… |
| Place: | ……………………………………………… |
| Describe the weather conditions: | ……………………………………………… |

**Key indicators of solar PV system**

|  |  |
| --- | --- |
| Total annual generation (MWh): | ……………………………………….. (P50)  ……………………………………….. (P75)  ……………………………………….. (P90) |
| Specific annual output (kWh/kWP/year): | ……………………………………….. |
| Performance Ratio (%): | ……………………………………….. |

**Grid information**

|  |  |
| --- | --- |
| NEA grid connection type  *(Single phase, three phases)* |  |
| Incoming grid voltage (V) |  |
| Number and size of transformers | Numbers: ……………….  T1 (kVA): ……………….  T2 (kVA): ……………….  T3 (kVA): ……………….  T4 (kVA): ………………. |
| Institution operating voltage (V) |  |
| Average monthly electricity cost (NPR) |  |
| Describe the average frequency of grid downtime per day |  |
| Describe the duration of grid downtime |  |
| Peak load of institution |  |

Describe the load-test performance of the system by observing it for a day. Write your observations and findings below.

**SECTION I**

**(SOLAR PV SYSTEM)**

|  |  |  |  |
| --- | --- | --- | --- |
| Rooftop solar PV on-grid site information | | | |
| Site address: |  | | |
| Latitude: | | Longitude: | Elevation(m): |
| Describe the weather conditions: | | | |
| Solar radiation and time of measurement: ………………W/m2; Time: ……………… | | | |
| Is the site located in a disaster-prone area?  (For example, *the* *possibility of landslides, earthquakes, floods, etc.)*  …………………………………………………………………………. | | | |
| On a scale of 1-5, how accessible is the roof?  Very Easy Easy Moderate Difficult  Very Difficult  Describe the access to the roof: …………………………………………… | | | |

**Electrical checklist**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Individual module specification | | | | |
|  | **Items** | **Units** | **Observations** | **Remarks** |
| 1. | Manufacturer |  |  |  |
| 2. | Model no. |  |  |  |
| 3. | Rated power peak | Watt |  |  |
| 4. | Open circuit voltage | V |  |  |
| 5. | Short circuit current | A |  |  |
| 6. | Rated voltage | V |  |  |
| 7. | Rated current | A |  |  |
| 8. | Efficiency | European efficiency |  |  |

Draw a basic layout of panel placement showing each block relative to each other

**N**

**PV array block information**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | Block ID | Block in front  (Mention which block lies in front of the block you are specifying) | Block behind  (Mention which block lies behind the block that you are specifying) | Azimuth  (*with reference to true south)*  Degrees | Panel-to-panel spacing  (mm) | Panel arrangement  *(Landscape or portrait)* | Roof specification *(RCC, sheet metal roof, tiled roof, etc.)* | Panel angle of tilt in degrees | Is there shading on any panel of the block?  (Yes/No) |
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**Solar panel checklist**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| String specification | | | | | | | | | | | |
| Str. ID: | **No. of panels in series** | **No. of panels in parallel** | **Circuit breaker rating**  **(A)** | **Open circuit voltage (Voc)** | **Voltage (Vmp)** | **Current (Imp)** | **Grounding connection (Yes/No)** | **Cable insulation**  **(Yes/No)** | **Cable labelling**  **(Phase or neutral)** | **Continuity check**  **(Ok/ Faulty)** | **Panel back temperature**  **(Degree Celsius)** |
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**DC circuit breakers**

Total number of DC fuses: ……………………….

Total number of DC MCBs: ……………………….

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SN | Items | Description | Measurement/Visual data | Remarks |
| 1. | Location/placement | *Check whether the MCB is placed in a safe location.* |  |  |
| 2. | Junction box protection type | *If indoor: min. IP54*  *If outdoor: min. IP65* |  |  |
| 3. | Physical damage | *Check for any physical damage, overheating, or faulty breakers.* |  |  |
| 4. | Input and output side Continuity. | *Check for the continuity between the input and output side.* |  |  |
| 5. | SPD in each DC input | *Check whether SPD is given in each DC input.* |  |  |
| 6. | Rating of SPD | *Rating in ampere* |  |  |

**On-grid inverters**

Manufacturer and model number: ….………………………………………………..

Max. efficiency/European efficiency (%): …………...………………………………………

The number of inverters used: ……………………………………………………

Maximum output current: …………………………………………… ……A

Maximum input current: .………………………………………… ……...A

IP rating: …………………………………………………….

Rated output voltage: ..………………………………………………… V

**Input side**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SN | Items | Description | Measurement/Visual Data | Remarks |
|  | Location/Placement | *Check whether the inverter is placed in a safe and dry place with proper ventilation. Check the manufacturer manual for detailed specifications.* |  |  |
|  | Physical damage | *Inspect for any physical damages. Ensure that inverter is in proper working condition.* |  |  |
|  | Continuity tests | *OK/Faulty* |  |  |
|  | Cable shoe | *OK/Faulty* |  |  |
|  | Input side disconnection device | *OK/Faulty* |  |  |
|  | Ground fault monitoring | *OK/Faulty* |  |  |
|  | DC reverse polarity protection | *OK/Faulty* |  |  |
|  | Inverter ground connection | *OK/Faulty* |  |  |
|  | Surge protection rating | *OK/Faulty* |  |  |

**Output Side**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SN | Items | Description | Measurement/Visual Data | Remarks |
|  | Connection type: | *What kind of connection does the terminal have? For example, screw terminals, ring terminals, fork terminals, etc.)* |  |  |
|  | Clearance of inverter | *The inverter manual has specific instructions on how to mount.* |  |  |
|  | Continuity tests | *OK/Faulty* |  |  |
|  | Cable shoe | *OK/Faulty* |  |  |
|  | Output side disconnection device | *OK/Faulty* |  |  |
|  | AC short circuit protection | *OK/Faulty* |  |  |
|  | Frequency of output signal | *Check the frequency of the output signal.* |  |  |

**Draw the connection arrangement of the inverters**

**Individual inverter specifications**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | Inverter ID | Capacity (kW) | Instantaneous input voltage  (V) | Instantaneous input current  (A) | Instantaneous output line-line voltage  (V) | Instantaneous output current  (A) | Total number of inputs available | Total number of inputs used | Total number of independent MPPT | Total number of MPPT used | Input MPPT range | Maximum MPPT voltage |
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**Draw the single line diagram (SLD) of the system clearly showing the incoming grid and the solar tapping point**

**AC combiner box**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SN | Items | Description | Measurement and observation | Remarks |
|  | Placement/ Installation | *Is the AC combiner box installed securely?* |  |  |
|  | Grounding of AC combiner box | *Check whether the AC combiner box is properly grounded.* |  |  |
|  | AC inputs | *How many AC connection points are in the combiner box? Are there any live connection points left exposed?* |  |  |
|  | Instantaneous voltage in the AC combiner box | *Measure the instantaneous voltage in the combiner box and ensure that it doesn’t exceed the rated value of the combiner box.* |  |  |
|  | Instantaneous current in the AC combiner box | *Ensure that the measured current doesn’t exceed the rated current capacity of the AC combiner box.* |  |  |
|  | Combiner box type | *Single-phase or three-phase?* |  |  |
|  | Protection rating | *The IP rating of the box. For indoors, a minimum IP54 rating is necessary and for outdoors, a minimum IP65 rating is needed.* |  |  |
|  | MCCB rating | *kA* |  |  |

**Cables**

**DC cables checklist**

**Cables from solar panels to DC combiner box**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | Cable from  *(String ID/ Panel ID)* | Cable to  *(DC breaker ID)* | Manufacturer | Armoured  /Unarmored | Phase wire color code | Neutral wire colour code | Size of cable | Conductor material | Number of cores | Cable termination materials | Cable Routing  *(Conduits, cable trays or others; specify)* |
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**Cables from DC Combiner Box to Inverter**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | Cable from  *(DC Breaker ID)* | Cable to  *(Inverter ID)* | Manufacturer | Armoured  /Unarmored | Phase wire color code | Neutral wire colour code | Size of cable | Conductor material | Number of cores: | Cable termination materials | Cable routing  *(Conduits, cable trays or others; specify)* |
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**AC cables checklist**

**Cables from inverter to AC breakers**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | Cable from  (Inverter ID) | Cable to  (Breaker ID) | Manufacturer | Armoured  /Unarmored | Phase wire color code  *(In case of three phases, write the colour code of each phase. Example RYB, etc.)* | Neutral wire colour code | Size of cable | Conductor material | Number of cores | Cable termination materials |
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**Cables from AC Breakers to AC combiner box**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SN | Cable from  (Breaker ID) | Manufacturer | Armoured  /Unarmored | Phase wire color code  *(In case of three phases, write the colour code of each phase. Example: RYB, etc.)* | Neutral wire colour code | Size of cable | Conductor material | Number of cores | Cable termination materials |
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**Tap-in point information**

|  |  |
| --- | --- |
| Incoming grid voltage: | …………………………… V |
| Transformer rating: | …………………………… MVA |
| Transformer low voltage rating | …………………………… V |
| Transformer high voltage rating | ……………………………V |
| Circuit breaker rating | …………………………… A |
| Voltage at tap-in point | …………………………… V |
| Current through tap-in point | …………………………… A |
| Current transformer (CT) rating | …………………………… |
| CT ratio | …………………………… |
| If a stabilizer is used, mention the stabilizer rating. | ……………………………MVA |
| Capacitor bank capacity | ……………………………kVAr |

**Control room**

|  |  |
| --- | --- |
| Size of the room (length x breadth x height) | …………………………………………………… |
| Construction type   1. Plastered/Unplastered 2. RCC/Sheet metal roofing | 1. …………………………………………… 2. …………………………………………... |
| Is the room partitioned or not? If yes, then what is the material used for partition *(brick wall, aluminium, etc.)* |  |

**Remote monitoring unit (RMU)**

|  |  |
| --- | --- |
| Is the remote monitoring unit built-in to the inverter or external? |  |
| If external, mention the name of the manufacturer and model. |  |
| Is the RMU based on WIFI or GPRS? |  |

**SECTION II**

**(Mechanical System)**

**Roof details**

|  |  |
| --- | --- |
| Slope: |  |
| The direction of slope: |  |
| Type of roof: |  |
| Describe the walking space between blocks for O&M. |  |

**Panel mounting structure**

|  |  |
| --- | --- |
| Type of structure: *(RCC, Steel frame, aluminium, etc.)* |  |
| Clearance between the roof and back of the panel (mm): |  |
| Mounting structure type: *(Adhesive type, Nut bolt type, welding type, etc.)* |  |
| Are all structures bolted/adhesive secure? (Yes/No) |  |

**Panel O&M checklist**

|  |  |
| --- | --- |
| Describe the panel cleaning mechanism*. (Manual, robotic, if others please specify)* |  |
| Are there dedicated people for the O&M of the project? If yes, please mention their name. |  |
| Is there availability of the O&M manual? |  |

**System performance**

1. If an online monitoring system is available, extract electricity generation data for 72 hours and conduct an analysis in reference to the design.
2. If an online monitoring system is not available, use a power analyser to record electricity generation data for 72 hours and conduct a performance analysis in reference to the design.

Method chosen:

|  |  |
| --- | --- |
|  | Data from online monitoring |
|  | Data from the power analyser |

Dates for which system data was obtained: from ………………….. to …………………..

**Present the data in charts in the project completion report.**

Comments on system performance during the checks:

|  |
| --- |
|  |