**CHAMUNDESHWARI ELECTRICITY SUPPLY CORPORATION LIMITED**

***(A Government of Karnataka Undertaking)***

# Operation and Maintenance Guidelines of Grid Connected PV Plants

1. For the optimal operation of a PV plant, maintenance must be carried out on a regular basis.
2. All the components should be kept clean. It should be ensured that all the components are fastened well at their due place.
3. During mandatory O&M period of 5 years, the rooftop solar PV plant has to be maintained by the vendor for the activity assigned to electrician/technician. The user shall be suitably guided by the vendor for all tasks lying in scope of the user and the user shall also be provided with appropriate documents for such guidance.

Maintenance guidelines for various components viz. solar panels, inverter, wiring etc. are discussed below:

# SOLAR PANELS

Although the cleaning frequency for the panels will vary from site to site depending on soiling, it is recommended that

* 1. The panels are cleaned at least once every fifteen days.
  2. Any bird droppings or spots should be cleaned immediately.
  3. Use water and a soft sponge or cloth for cleaning.
  4. Do not use detergent or any abrasive material for panel cleaning.
  5. Iso-propyl alcohol may be used to remove oil or grease stains.
  6. Do not spray water on the panel if the panel glass is cracked or the back side is perforated.
  7. Wipe water from module as soon as possible.
  8. Use proper safety belts while cleaning modules at inclined roofs etc.
  9. The modules should not be cleaned when they are excessively hot. Early morning is particularly good time for module cleaning.
  10. Check if there are any shade problems due to vegetation or new building. If there are, make arrangements for removing the vegetation or moving the panels to a shade-free place.
  11. Ensure that the module terminal connections are not exposed while cleaning; this poses a risk of electric shock.
  12. Never use panels for any unintended use, e. g. drying clothes, chips etc.
  13. Ensure that monkeys or other animals do not damage the panels.

# CABLES AND CONNECTION BOXES

1. Check the connections for corrosion and tightness.
2. Check the connection box to make sure that the wires are tight, and the water seals are not damaged.
3. There should be no vermin inside the box.
4. Check the cable insulating sheath for cracks, breaks or burns. If the insulation is damaged, replace the wire
5. If the wire is outside the building, use wire with weather-resistant insulation.
6. Make sure that the wire is clamped properly and that it should not rub against any sharp edges or corners.
7. If some wire needs to be changed, make sure it is of proper rating and type.

# INVERTER

* 1. The inverter should be installed in a clean, dry, and ventilated area which is separated from, and not directly above, the battery bank (if applicable).
  2. Remove any excess dust in heat sinks and ventilations. This should only be done with a dry cloth or brush.
  3. Check that vermin have not infested the inverter. Typical signs of this include
  4. Spider webs on ventilation grills or wasps’ nests in heat sinks.
  5. Check functionality, e.g. automatic disconnection upon loss of grid power supply, at least once a month.
  6. Verify the state of DC/AC surge arrestors, cable connections, and circuit breakers.

# SHUTTING DOWN THE SYSTEM

1. Disconnect system from all power sources in accordance with instructions for all other components used in the system.
2. Completely cover system modules with an opaque material to prevent electricity from being generated while disconnecting conductors.
3. To the extent possible, system shutdown will not be done during daytime or peak generation.

# INSPECTION AND MAINTENANCE SCHEDULE:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Compone**  **nt** | **Activity** | **Description** | **Interval** | **By** |
| PV | Cleaning | Clean any bird | Immediately | Beneficiary |
| Module |  | droppings/ dark spots |  |  |
|  |  | on module |  |  |
|  | Cleaning | Clean PV modules with | Fortnightly or as | Beneficiary |
|  |  | plain water or mild | per the site |  |
|  |  | dishwashing detergent. | conditions |  |
|  |  | Do not use brushes, any |  |  |
|  |  | types of solvents, |  |  |
|  |  | abrasives, or harsh |  |  |
|  |  | detergents. |  |  |

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| --- | --- | --- | --- | --- |
|  | Inspection (for plants > 100 kWp) | Use infrared camera to inspect for hot spots; bypass diode failure | Annual | Technician |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Activity** | **Description** | **Interval** | **By** |
| PV Array | Inspection | Check the PV modules and rack for any damage. Note down location and serial number  of damaged modules. | Annual | User/Technician |
| Inspection | Determine if any new objects, such as vegetation growth, are causing shading of the, array and  move them if possible. | Annual | User/Technician |
| Vermin Removal | Remove bird nests or  Vermin from array and rack area. | Need basis | User/Technician |
| Junction Boxes | Inspection | Inspect electrical boxes for corrosion or intrusion of water or insects. Seal boxes if required. Check position of switches and breakers. Check  operation of all  protection devices. | Annual | User/Technician |
| Wiring | Inspection | Inspect cabling for signs of cracks, defects, loose connections, overheating, arcing, short or open  circuits, and ground faults. | Annual | User/Technician |
| Inverter | Inspection | Observe | Quarterly | Electrician |
| Compone  nt | Activity | Description | Interval | By |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Instantaneous operational indicators on the faceplate of the inverter to ensure that the amount of power being generated is typical of the conditions. Inspect Inverter housing or shelter for physical maintenance, if  required. |  |  |
| Inverter | Service | Clean or replace any air filters. | As needed |  |
| Instrumen ts | Validation | Spot-check monitoring instruments pyranometer etc.) with standard instruments to ensure that they are operational and within specifications. | Annual | PV Specialist |
| Transfor mer | Inspection | Inspect transformer  oil level, temperature gauges, breather, silica gel, meter, connections  etc. | Annual | Electrician |
| Tracker (if  present) | Inspection | Inspect gears, gear boxes, bearings as required. | Annual | Technician |
|  | Service | Lubricate tracker  mounting bearings, gearbox as required. | Bi-annual | Technician |
| Plant | Monitoring | Daily Operation and Performance Monitoring | Daily | Beneficiary |
| Inverter | Inspection | Observe instantaneous operational indicators on the faceplate of the inverter to ensure that the amount of power being generated is typical of the conditions.  Inspect Inverter housing or shelter for physical  maintenance, if required. | Quarterly | Electrician |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Inverter | Service | Clean or replace any air  filters. | As needed | Electrician |
| Instrumen ts | Validation | Spot – check monitoring instruments(pyranometer etc.) with standard instruments to ensure that they are operational and  within specifications. | Annual | PV Specialist |
| Transfor mer | Inspection | Inspect transformer  oil level, temperature gauges, breather, silica gel, meter, connections  etc. | Annual | Electrician |
| Tracker  (if present) | Inspection | Inspect gears, gear boxes, bearings as required. | Annual | Technician |
| Service | Lubricate tracker  mounting bearings, gearbox as required. | Bi-annual | Technician |
| Plant | Monitoring | Daily Operation and Performance Monitoring | Daily | Beneficiary |
| Spare  Parts | Management | Manage inventory of spare  parts. | As needed | Site in charge |
| Logbook | Documentati on | Document all O&M activities in a workbook available to all service  personnel | Continuous | Site in charge |

**Operation and Maintenance Guidelines of Grid Connected PV Plants**

1. Periodic cleaning of solar modules, preferably once every fortnight or as per site conditions. As this task has to be done by the beneficiary, the vendors shall apprise the beneficiary on the importance and proper technique for cleaning.
2. O&M of Solar Power Plant shall be compliant with grid requirements to achieve committed energy generation.
3. Periodic checks of the Modules, PCUs and BoS shall be carried out as a part of routine preventive and breakdown maintenance.
4. Immediate replacement of defective Modules, Invertors/PCUs and other equipment as and when required.
5. Supply of all spares, consumables and fixtures as required. Such stock shall be maintained for all associated equipment and materials as per manufacturer/ supplier’s recommendations.
6. All the equipment testing instrument required for Testing, Commissioning and O&M for the healthy operation of the Plant shall be maintained by the Bidder. The testing equipment must be calibrated once every 2 years from NABL accredited labs and the certificate of calibration must be kept for reference as required.
7. If negligence/ mal operation on part of the Bidder's operator results in failure of equipment, such equipment should be repaired/ replaced by the Bidder free of cost.