Pre-Commissioning Check

Solar Power Plant

The parameters in an inverter should be set according to the local grid conditions, before starting the operation. Inverters are the heart of any solar power plant. this is known as commissioning the Inverter. If you are well equipped it is as easy as setting up a new Mobile.

Every installer/solar developer's main motto would be good generation with reduced service maintenance. This can be achieved only by prior checking of the plant before commissioning.

A prior checking involves the proper string sizing, polarity check, earthing check, protective devices check and the grid parameter check.

"An inverter will never generate power; the power is generated by a DC source and inverter only converts DC to AC".

In a solar plant, the DC source is the DC power from PV arrays which are formed by connecting solar Modules in series. The output from PV array comes as positive and negative cable, they are together called as a String. Number of strings vary from one to many, as per the plant capacity. These strings are given as the DC input to an inverter.

Pre-commissioning checklist for a solar string inverter.

In the case of Solar string inverters, the inverter will have a multiple MPPTs and Multiple string inputs designed according to the given MPPT.

Consider a 330Wp PV panel, a 10kW inverter with a 2 MPPT and 3string input(2x1).

***Note the inverter input will vary according to the manufacturer.*

Now, the system will have a 30 Nos of panels with 9.9kW DC input(30*0.330=9.9kW).

The installer must first check the panel to panel grounding link and panel to earth grounding before connecting it as a single string.

The string calculation will involve, the open circuit voltage of panel and maximum MPPT input voltage of an inverter.

Assume Voc to be 45V for a 330Wp panel and the Vmax MPPT is 1000V.

The string sizing would be number of panels multiplied with Voc which should not exceed the inverter Vmax MPPT i.e., 1000v.

Ground Fault check.

Before connecting it to inverter, the installer must check the string for ground faults between positive and negative end of string and Voc between positive to earth and negative to earth.

Let's say the installer has given two strings 15 panels in one string and other 15 in another string.

On a properly earthed system:

- The Voc between +ve and -ve is 675V(15*45V=675V) hence the +ve to earth should be less than 60V on a floating value. Likewise, to Negative to earth.

If all measured voltages are stable.

- The sum of the two voltages to ground potential is approximately equal to the voltage between the positive and negative terminals.

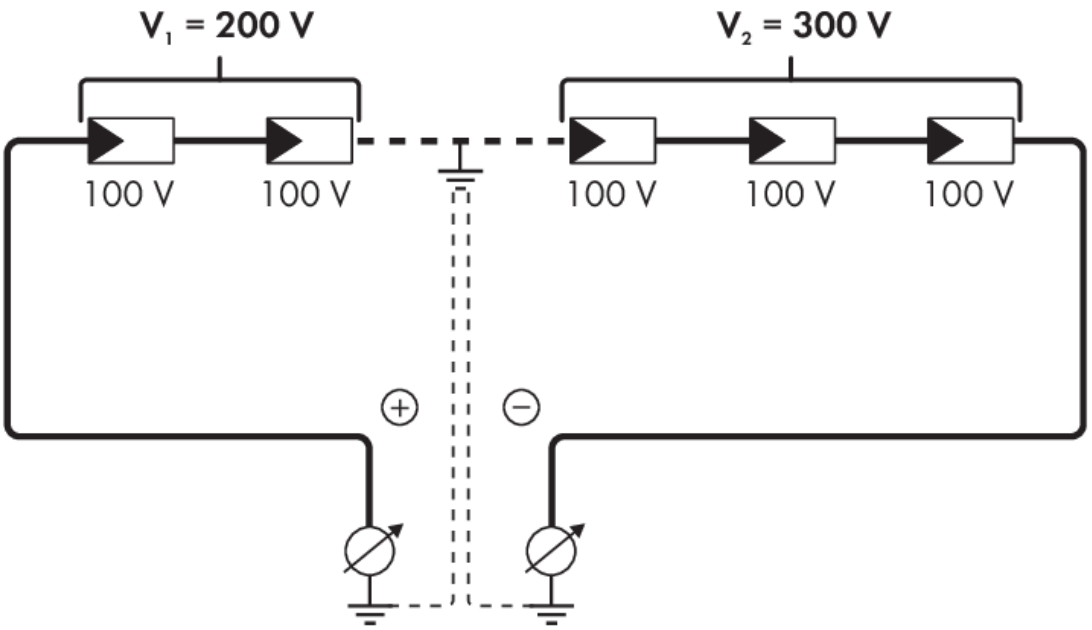
Let's say, +ve to earth is 225V and -ve to earth is 450V. Then there is a ground fault in the system.

The installer can identify the fault by finding the ratios of these two voltages.

Possible causes for this are, damaged PV connectors, DC cables or PV modules.

The example shows a ground fault between the second and third PV module.

Source of Image: SMA Events Troubleshooting Guide.



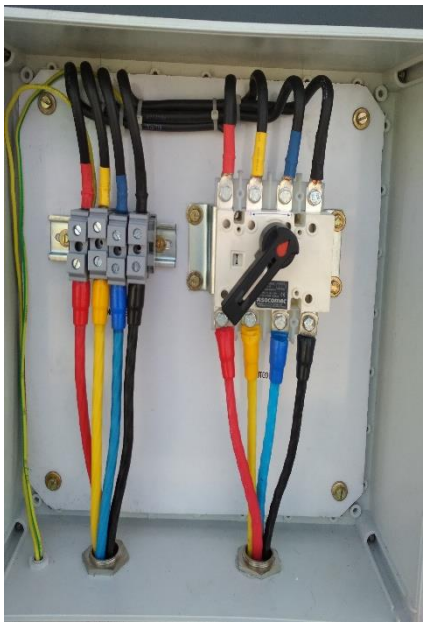
Pointers:

- Now from the DC side, the strings are checked for grounding issues.
- Make sure the MC4 connectors are crimped properly, those are the ones which carry high DC voltage.
- We all know loose contact in an electrical system are very good friend of fire. Most of the loose contacts happens at the AC Side terminal level.
- In-order to reduce the cost, the installer should not compromise on the Balance of System. Safety First is the first principle of Engineering.
- Do not reduce the AC cabling size to reduce the cost of the system.

In a 10kw inverter the maximum output current in a single phase will be 14.5 Amps. So clearly the system will require an equivalent or larger cross section cable to drive the current without any stress.

- Always consider the distance while selecting the AC cable cross section. More the distance, higher will be the voltage loss. For long distances, use high-density AC cables.
- While crimping AC terminal, the sleeves of the AC gland must be properly taken as prescribed by the manufacture on installation manual and it should be properly isolated. A well isolated system is a very good system.

Properly crimped cables in ACDB.



Effect of loose contact, if left unchecked

- Loose contacts might not trigger an immediate result on the inverter, but over time the cable will be degraded due to the heat accumulated and will result in lethal fire. Maintain a routine check to avoid these events.
- Check if the protective devices given are connected properly to the system.
- An inverter is the expensive component, so the protection should be highly enabled. An installer must not compromise on the quality of protection.

Apart from the details discussed above, every electrical system requires earthing.

Earthing in an electrical system is provided to ensure the safety of installation by reducing the fault leakage currents. This dangerous fault current is caused due to many reasons and therefore it is very important to ensure the system is well earthed according to the guidelines of IEC Standard.

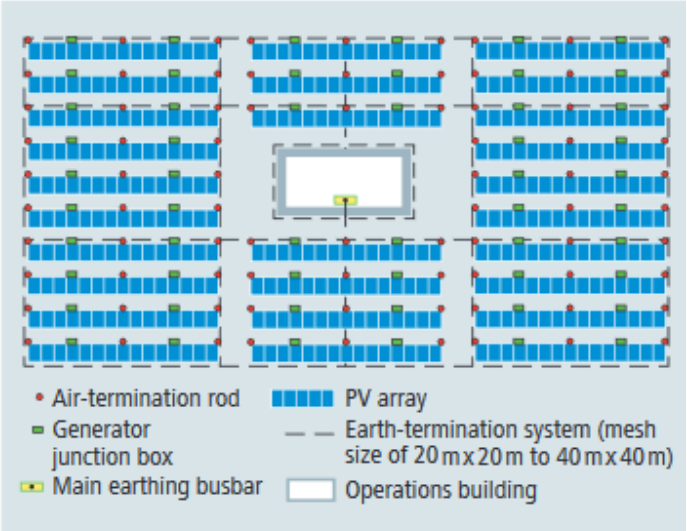
The solar plant earthing is divided into two major categories DC Side, AC Side as per the IEC 60364-7-712.

DC Earthing

- An installer must ensure that, lightning arrestor are provided for complete system and its properly connected to a separate earth pit and its resistance is less than 10 ohms as per the IEC 62305-3.

Example of Earth Termination System

Source of image: DEHN – International (PV -free field)



- Installer must Identify and visually inspect each component involved and check if there is any damage or breakage on panels and cables.
- Panel to panel earthing and the panel to structure earthing must be checked.
- The structure earthing is interconnected using a flat earth strip rod and given to the earth pit.
- The design of earth cable and earth strip depends upon the maximum short circuit current that can possibly happen on the system. The installer must check the Maximum short circuit current of the PV Panels and the PV generator.
- The number of earth pit provided to the system will depend upon the capacity of the power plant and how much area covered by the components involved.
- The resistance of earth pit should be less than 2 ohms for a properly earthed system. An installer must check the resistance using an Ohm meter and make sure that it is below 2 ohms.

AC Earthing

The grid tie inverter will not produce any power if it senses isolation fault from the PV panels or if there is any earthing fault on the grid side. It will isolate from power production if the AC voltage reference is unavailable or if it's not under the specified limit(ref., IEC 62116).

(To identify the isolation fault from PV panels please refer above **Ground fault checking procedure**)

- The installer must verify the AC voltages between Phase to Phase, Phase to Neutral and Neutral to Earth and all these values must be under standard parameters of their respective country. Ensure the conductors are covered using glands to protect from Insects and Pests.
- The N-E value will be less than 5V in a properly earthed system.
- The inverter body must be earthed to avoid danger to the person contacting it.

Insulation Resistance Check of cables.

Another factor for an earth leakage is puncture on cables. A visual inspection over the AC and DC conductor cables must be made. Sometimes this might not be noticed to a naked eye.

- Therefore, the installer must check the insulation resistance of cables using an Insulation Resistance meter (Ohm Meter) before commissioning.
- The pointer will read 0 if there is short circuit inside conductor and it will read infinity if there is open circuit i.e., if the cable cut down.

- Each cable in the system, AC and DC carrying conductors must be tested before connecting it to loads. If the system is not earthed and it is connected to the loads, the leakage current will flow through the least resistance path available or contacting it resulting in a heavy damage to a personal safety and the equipment's that are connected. Hence, earthing is important.

The installer can commission the inverter once he confirms all the pre checklist has been done and verified.

Setting up the Inverter:

- The inverter must be commissioned according to the grid parameters of the country.
- Each inverter user interface will vary according to its manufactures. The initialization and how to set up the inverter will also be instructed in the installation manual.
- Most of the installer leave the system un-commissioned after confirming the input and output. The inverter will work fine but without setting it up, it will result in various events disturbing the power generation.
- A routine check of all the connectors, cables must be made.

For an undisturbed power generation for next 25 years, one should not comply on quality of products.

References:

1. *SMA Events Troubleshooting guide*
2. *EARTHING AND LIGHTNINGOVERVOLTAGE PROTECTIONFOR PV PLANTS - Xavier Vallvé,Trama TecnoAmbiental*
3. *EARTHING FOR PV PLANTS - V.R. V*
4. *Lightning and surge protection for free field PV power plants - DEHN International*

Author:

Syed

Technical Engineer

Academic Editor:

Nishitha S

Communication Manager

evolve
Energy Group