Alternative Energy

Chapter 4 Part 3: Balance of System - PV System Cabling and Protection

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Chapter Description

- Expected Outcomes
  - describe about the PV system cabling and protection

- References
  - Grid-connected Solar Electric Systems: The Earthscan Expert Handbook by Geoff Stapleton and Susan Neill, 2010.
  - Stand-alone Solar Electric Systems: The Earthscan Expert Handbook for Planning, Design and Installation by Mark Hankins, Earthscan, 2010.

BOS equipment

The rest of the BOS equipment are:

- ✓ The inter—array cabling and cabling to the array junction box
- ✓ The array junction box (sometimes called DC combiner box)
- ✓ The main cable from the array junction box to the inverter
- ✓ String Protection and disconnect switches - fuses and/or circuit breakers
- ✓ Lightning protection which include surge protection devices (SPD’s) and earthing
- ✓ The DC and AC main switches
- ✓ The AC cabling from the inverter

Cable

- They should be double-insulated for protection against short circuits; mostly positive and negative lines are carried in different cables.
- As the string cables are subject to the weather, solar radiation and high temperatures, they must be UV resistant, flame retardant and designed for high operating temperatures.
- Solar connectors have been developed for connecting the modules and these provide simple and safe connections

Cable

- Typical cable sizes available include: 1.5 mm^2, 2.5 mm^2, 4.0 mm^2 and 6.0 mm^2.
- These sizes will be suitable for the majority of installations.
- An important criterion is selecting a cable that meets the output current and output voltage of the PV array and minimizes voltage drop.

Cable

- AC cables
  - In PV Grid-Connected systems, AC cables are used from the inverter to the kWh meter; onto the AC main switch; and then to the grid connection.
  - The voltage from the inverter is typically 240 V AC (single phase) and the cables required are the same cables used in general household/building cabling.
  - In the larger systems the inverters can be 415 V AC (three phase).
  - For single phase inverters the cable will be 3 cores while for three phase inverters it will be 5 cores.

Cable

- Earthing cables
  - This is the standard earthing cable used in the wiring of buildings.
  - For the frame of PV array to the earth of the building the cable should be at least 10 mm^2.
  - Earthing cables are also from the SPD's to the earthing system of the building.

Protection

- String protection and disconnect switches
  - Each PV string shall have a string protection device installed.
  - The strings shall also be able to be disconnected individually.
  - Therefore these requirements can be met by either using a fuse with an isolator switch or just a circuit breaker.
- PV main disconnect switches
  - A double pole load breaking DC rated isolating switch (disconnect) shall be installed on the DC side of the inverter while a double pole load breaking AC rated isolating switch (disconnect) shall be installed on the AC side of the inverter.
  - The AC switch is installed between the kWh meter and the grid connection.
  - Both the DC and AC array main switches shall be rated for the voltage and current of the system.

Protection

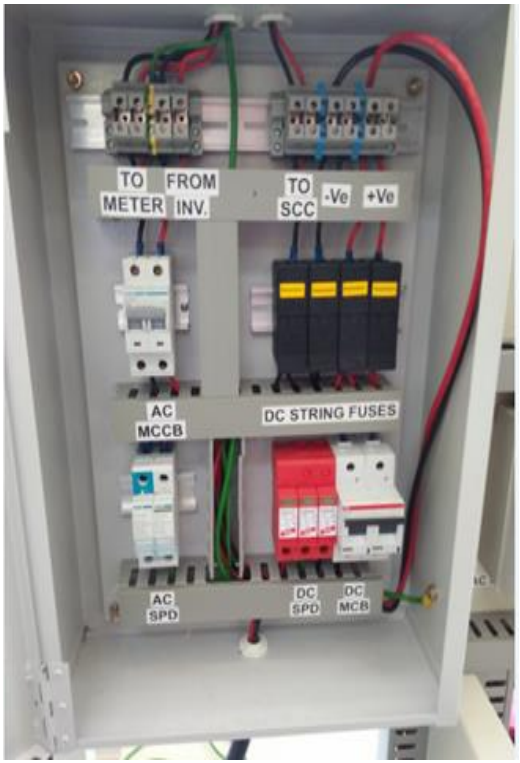
Lightning protection

- For lightning protection, it is recommended to install Surge Protective Devices (SPD's).
- The SPD's shall be installed as follows:
  - A. On the DC side:
    - One between negative and earth
    - One between positive and earth
    - One between negative and positive
  - B. On the AC side:
    - One between live and earth
    - One between neutral and earth
    - One between live and neutral

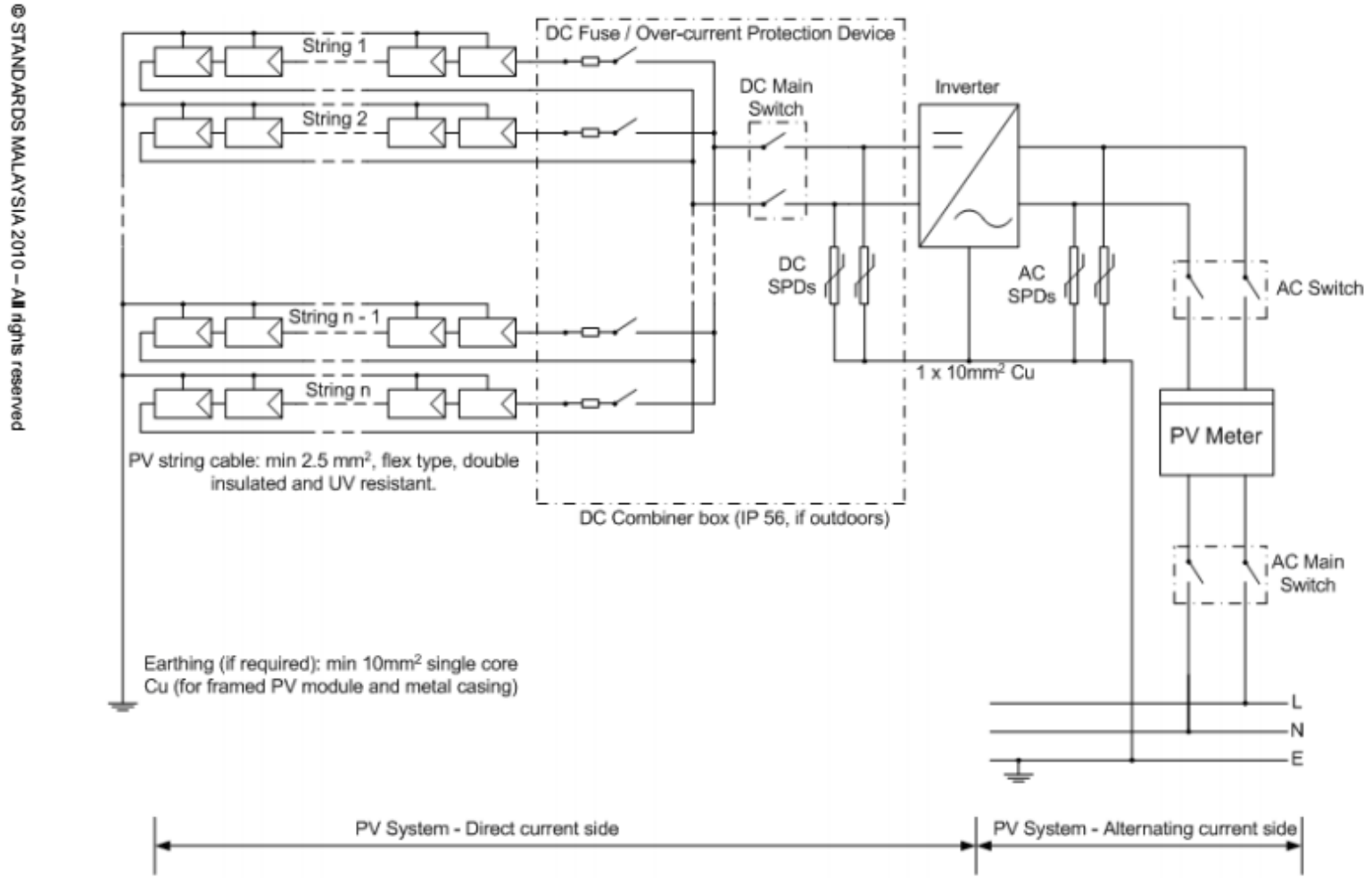
Array Junction Box

- The cables from the array strings are typically interconnected in an *array junction box*, sometimes called *DC combiner box*.
- If there are multiple parallel strings then the array junction box will facilitate the combining (connection) of the positive and negative cables from the different strings on links or similar and then allowing only one positive and negative array cable interconnecting with the inverter (via the DC main switch).
- The array junction box will typically house the string protection, disconnection devices and the SPD's on the array cable.
- Depending where the array junction box is physically located it could also house the DC main switch.

Example of Array Junction Box



Complete wiring diagram of a grid-connected PV system



Source: MS 1837:2010 INSTALLATION OF GRID-CONNECTED PHOTOVOLTAIC (PV) SYSTEM (FIRST REVISION)Department of Standards Malaysia (STANDARDS MALAYSIA)

Thank You