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Bringing new ideas to renewable energy

Criteria for Inverter Selection

The purpose of this document is to provide a checklist when considering selecting a Solar PV Inverter.

AC Voltage: In the US, we can face a multitude of AC operating voltages as well as single or three-phase systems;

1) 120/240- single phase is used in residential applications. Inverters would connect to 240VAC in this application.
2) 240- three-phase is used for power loads in commercial and industrial buildings. This is a delta configuration. Across any one (of 3 transformers) there's 240V. On one side (only) of the delta. There is a center-tapped transformer which is connected to neutral. Thus providing 2x 120VAC for outlets.
3) 208Y/120-V three-phase four wire distribution is commonly used in commercial buildings with limited electrical loads. 120V is available between a pole and ground, while 208V is available between any two poles.
4) 480- Three phase delta is commonly used in commercial and industrial buildings with substantial motor loads.
5) 480Y/277- is used to supply commercial and industrial buildings. Between any two poles there's 480V, and between any pole and neutral there's 277V. The 277V is used for ballasted lighting. Local step-down transformers are typically inserted to provide 208Y/120-V power for lighting, appliances and outlets.

DC Voltage: For inverters we have the following parameters when considering DC voltages;

1) The Maximum Power Point Transfer (MPPT or MPP) voltage range. This is the voltage range where the inverter employs its software algorithm to adjust its DC input impedance to that of the solar system. A solar PV string should be sized such that the inverter can normally operate within this range.
2) Maximum DC voltage; a solar PV string with no load (Vo) must under no circumstance ever exceed an inverters maximum DV voltage. When considering this factor, one must assume the lowest possible solar PV panel temperature while exposed to bright sunlight. This usually happens on a winter day with cumulus clouds. Here in Los Altos California, it is safe to assume a T(min) of -10C.

3) Minimum DC voltage; for tracking systems, the minimum DC voltage at which the inverter remains on-line is particularly critical to concentrated solar PV tracker performance. During cloud cover, a solar PV string's DC voltage can drop to a very low level. At some point, the inverter will decide to all-together stop production, and proceed with shutdown. Upon cloud clearing, a shut-down inverter, must now go through a start-up procedure during which it must monitor the AC voltage and frequency for a given time interval before going on-line.

String sizing: Solar PV panels or receivers should be connected in series to form "strings". Strings should be connected in parallel to match an inverters power rating. A 10KW inverter should not be used together with a 1KW solar PV plant, because the inverter will never operate at its peak efficiency level. Inversely, a 10KW solar PV string should not be used to power a 1KW inverter. In this case, assuming VDC is not being violated, the inverter will simply produce 1KW.

String considerations for tracker operations: A single tracker in an open field has no special requirements to string layout. On the other hand, as more trackers are added to a field, and the spacing between trackers become more dense, trackers will inevitably shade their partners during early morning and late afternoons. This is a particularly important time because is happens to be at the time of day where;

1) the largest gain is made by using tracking vs. non-tracking
2) in the late afternoon, the energy costs are at their highest

While shading ultimately is inevitable, designing the proper string layout can mitigate the shading issue. Consider a simple heliostat, ie. a solar PV-panel-equipped-plane with 3 rows, which is pointed perpendicular to the sun. Rather than having a given solar PV string run zigzag between top, middle and bottom rows, it would be better to have a top, middle and bottom string. For commercial fields where 3-phase wiring is used, one may even consider installing 3 distinct inverters for each of the rows, where each inverter feeding 1 of 3 phases. Thus affording a dedicated MPP unit for each string.

A solar PV's DC circuit should feed one and only one inverter.

Communication: Most inverters offer a communication port for data feed. Rarely is it used to control inverter operation. In some circumstances, the communication port can offer substantial diagnostic information such the Xantrex Oscillograph feature which can capture a real-time image of parameters prior-to and following a fatal inverter fault.

Most communication ports use RS485, while CAN-bus is implemented on a few (such as Xantrex low-end). RS485 is an electrical standard. Modbus defines a communications protocol used with a RS485 network, and is used among a few inverter manufacturers.