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Factors To Be Considered For The Selection Of A Grid Connect PV Inverter

The Indian Solar market is on a continuous growth having strong fundamentals & future prospects due to Irradiation in abundance and a short and expensive supply of power. With the new policy drafts, the future looks promising. The question arises here:

Are we taking care of the design criteria to make a PV plant long lasting? Are we choosing the right product as per the requirement?

The design criteria of a grid connect PV plant may include a lot of considerations like budget, roof space, annual electric usage, government subsidy rules, other customer related criteria, but whatever is the final design, every accredited designer should be able to:

- Govern the energy yield and specific yield of the grid connected PV system.
- Finalize the inverter size based on the size of the array.

- Match the array configuration to the selected inverter's voltage specifications.

As we speak, "The inverter is the heart & the brain of a PV plant". Inverters often have 10 to 20 year warranty, but they are typically the most failure prone part of a PV plant. The foremost factors to consider when selecting an inverter for a utility-scale solar plant can be broadly defined as:

- Technology
- Performance
- Financial

It is important to carefully consider each of these risks in order to minimize adverse financial impact to utility scale projects. The selection of the inverter for the installation will depend on:

- The energy output of the PV array.
- The matching of the allowable inverter

string configurations with the size of the array in kW and the size

There are many industrial resemblances among manufacturers, understanding both the points of commonality and the divergences are critical. The subsequent parameters will aid one to choose the right inverter as per their requirement for the project:

➤ **Topology** – Depending upon the project requirement and the capacity, one can select the product based on IGBT or FET, String or Central, Transformerless or with transformer. The topology might be common but the implementation can differ significantly. These differences only determine the better products.

REFUsoL String Inverters are highly efficient Transformerless inverters with reduced losses.

For a 1MW plant, multiple string inverters will be there on the field. The question here comes: Why Multiple Inverters?

- Multiple inverters allow a portion of the system to continue to operate even if one inverter fails. In short, redundancy is very high.
- Multiple inverters allow the system to be modular, so that increasing the system involves adding a predetermined number of modules with one inverter.
- Multiple inverters balance the phases better in accordance with local utility grid.
- Lastly, multiple inverters will act as multiple MPPT on the field which will maximize the output of the total array.

➤ **AC Voltage** – The selection of inverters on the basis of output voltage and phase (whether single or three phase) subjects to the stringent requirement as per the national grid, the availability of grid and overhead transmission line at site location.

➤ **DC Voltage** – A Solar PV string with No load also, must, under no circumstance ever exceed an Inverters maximum DC Voltage. When considering this factor, one must assume the lowest possible PV panel temperature while exposed to bright sunlight. The higher system voltage results in reduced losses. Currently, the market is offering 1000V dc, but in the coming years the products will be rated at a maximum withstand of 1500 Vdc.

➤ **MPPT efficiency** – Maximum power point tracker (MPPT) efficiency is another consideration in evaluating inverter performance. Perhaps, one should keep in mind, that a 1% loss in MPPT efficiency has the same effect on harvest as an equivalent loss in conversion efficiency. The MPPT voltage range is where the inverter employs its software algorithm to adjust the DC input to that of the PV system. The voltage range should be wide enough for the inverter to operate on full load. REFUsoL inverters have 99.9 % efficiency of MPPT with a wide range of MPP Voltage. The algorithm of the inverter should be very fast & precise so that it covers shadowing. REFUsoL inverters have an Active Shadow Sweep function which covers shadowing and clouding as well.

➤ **Inverter efficiency** – The performance of the inverter is closely tied to technology risk. By efficiency, we are really saying, what percentage of the power that

goes into the inverter comes out as usable AC current. Inverter efficiency directly impacts the ability to maximize harvest, which is the ultimate goal. The first thing to consider is the operating condition under which a given efficiency number is achieved. Inverter's efficiency can be increased by reducing the operating voltage window. A 96% efficient inverter will harvest the same or more than a 96.5% efficient inverter that has a smaller operating voltage window. Another way to increase the efficiency is to consider the way it operates its array. Alternate array segments are placed in series, instead of parallel, to increase the voltage rather than current, with which the inverters operating voltage will increase which results in the increase of the efficiency of the inverter. (Array imbalance losses should be taken into consideration). REFUsoL 17K is certified to have the highest efficiency worldwide by Photon Lab.

➤ **Other factors to be considered :**

- **Cooling** – Inverter should have a good cooling system, to operate at higher temperatures. Natural Convection is good for small inverters but as the power increases, forced air cooling will be preferred.
- **Finance** – An inverter should be commercially viable. The pricing should be favorable for both customer & manufacturer.
- **User Friendly** – It should be a user friendly device with no complexities. No special training should be acquired by the customer for the same. REFUsoL inverters are a complete plug & play, user friendly and a menu driven system. Remote monitoring will be an added advantage to the customer. REFUsoL will monitor all the parameters with the help of an inbuilt data logger.
- **Transportation** : The inverter should be light weighted and compact in sizing, so that it's easy to transfer to different places, adapting the required mode of transport. It will reduce the cost of transportation.
- **Ingress Protection**: Before deciding on the protection, one should analyze whether the application is indoor or outdoor. IP65 inverters will be installed outside and will reduce the cost with a

significant difference. REFUsoL string inverters are IP 65 thereby reducing the cost of construction required by a central inverter.

- **Installation & Service Support** : The unit must be easy to lift and install requiring least man-power and uptime should be very high. REFUsoL replaces string inverters under warranty.
- **Reliability**: One of the most important aspects of technology risk is related to inverter reliability and expected asset life. For the quality & reliability of the inverter, the product should have IEC certification, third party certification, VDE, BDEW, CE etc.

A long-term experience can be evidenced through the following:

1. History of producing the products in volume
2. Strong backgrounds with related products.

Considering these factors may provide better results than Mean Time between Failure calculations for a year old product.

Summarizing it, I would say, thoughtful consideration & calculations should be given to actual field data. In addition, a vendor's ability to provide extended support, stand behind long term warranty, perform assessment including both technical & commercial expertise, will help in minimizing inverter related jeopardies and increase the probability of success for the years to come.

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