Actual Site photograph of MSAT100, Mahindra Susten's Single Axis Tracker installed at 1.8 MWp plant in AP

Guidelines for Selection of Solar Trackers for Large Scale Solar Power Plants

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Introduction:

Single Axis E-W Horizontal Solar trackers are capable of enhancing the power generated from PV panels by 16-24% over fixed tilt systems depending on the site. Although this technology has been in existence for more than 5 years now, its application to large scale utility plants in Indiahas just begun picking up.Anumber of tracker suppliers with different tracking technologies are present in the Indian market.This has created a need for developers to evaluate the right technology keeping in mind factors such as, ease of installation, maintenance, availability of spares, reliability and lifecycle costs of the technology. This article will lay down a set of guidelines that will simplify and help evaluate various tracker technologies.

Think beyond the offer price – Look at lifetime cost

Tracker products at macro level may seem similar and suppliers can take attention away from minute technical details by making the upfront Capex cost very attractive. It is natural to base the purchase decision purely on the offer price in such cases. But the devil is in the detail, selection of a poor tracker can significantly undermine the benefits of using them and cause significant installation, maintenance and reliability issues. Here are a few decision metrics along with their influence on the above issues:

1. **Type of Tracker:** The first decision to be takenis exercising the choice between a single axis (SAT)or a dual axis tracker (DAT). ASAT moves only in the East-West direction vertically, whereas aDAT can rotate horizontally as wellresulting in greater energy generation. But, the ratio of additional power to additional investment made in upgrading from a fixed system to a SATmechanism is roughly 2 to 2.5 against a ratio of only 1.2- 1.25 in using DAT. Also, maintenance costs incurred on the latter is much more than the former due to greater complexity besides additional land. Hence, at present, it makes economic sense to use SAT.

2. **Tracker Configuration:** Next decision is to finalize the configuration. There are two main configurations available in the market namely Building Block (BB) and Independent row (IR). ABB essentially connects a single driving motor to multiple rows of modules, an IR type has one motor per row. Independent Row trackerprovides at least fivemainadvantagesover the Building Block Type tracker:
   - Site levelling cost incurred during installation of Independent Row tracker isless compared to BB as the disjoint rows take care of undulations over a large area. Selection of BB in an undulated site could significantly increase the installation costs, estimation is up to 2 lakhs/MW.
   - Independent rows with assigned trackers enable customized fine tuning thereby ensuring maximum energy efficiency of modules.
   - Effect of failure of tracker is restricted only to that particular row in an Independent Row Tracker. Hence, power loss due to downtime is localized and minimized. Thus, IR has enhanced system reliability.
   - Module cleaning and other maintenance activities are easier in IR system due to greater manoeuvrability.
   - Better Land Utilization and thus minimizing area per MWp when using an IR configuration.

3. **Ease of Installation:** Another important consideration is the ease of installation both structural and electrical. The tracker design should be simple enough to the extent that it doesn't add any additional time or need any special training for installation. On the electrical front, absence of inbuilt power source for trackers could significantly increase site cabling requirements. Here too, there are two types of Tracker systems available.
   - Type 1 - Externally powered with input from the Inverter Room.
   - Type 2 - Self powered with dedicated PV modules and energy storage module for each trackeror combination of trackers

   Type 2 Trackers will not only ease the need for cabling at site but will also not need additional Auxiliary supply. The cost savings will be INR ~1 lakhs/MWpdue toreduced auxiliary cablesupply & installation besides reducing the hassles involved in cable handling. It also saves INR ~0.3 lakhs/MWp on account of no auxiliary consumption every year.Additionally, it is also important to see if the trackers are supplied with integrated & localized batteries for power backup. If this is not the case, then the user has to spend close to Rs.1.25 Lakhs/MW on UPS, battery and cables.

   Communication system between controllers is another critical feature in a tracker. Here again, there are two kinds available.

   - Type 1 - Wired channel that makes use of Modbus &
   - Type 2 - Wireless

   Similar to auxiliary power cables, usage of Modbus cable would entail an additional material cost of around INR ~0.4 lakhs/MWpon the user during installation. Furthermore, SCADA system used must be user friendly and tightly integrated to the hardware.

4. **Structural Essentials:** On the structural front, it is important to look at the number and type of foundation required per MW for each tracker under consideration.Depending on the type of soil and tracker design these may vary significantly.Similarly, the type of connection between vertical post and horizontal tube has a direct influence on the smooth and reliable functioning of the tracker.

   There are different kinds of joints,some patented by the suppliers, available in the market. Self-Lubricated bearings which have been tested for few years of operation should be the preferred choice. Both foundation and joint type directly affect installation & maintenance time and cost.

   Apart from the above factors, it would be wise to confirm whether the material used for structure and the tracker design are suitable for local environmental conditions including corrosivity of soil, humidity, irradiance in the area, wind pattern & velocity. There should be some form of environmental testing done for the design or some reliability tests to prove the suitability under harsh site conditions.

5. **Performance, Credibility and Reliability**

   The tracker system needs to operate for 25 years and hence the reliability of the entire system needs to be proven. Most tracker companies have installation base only from the last 1-2 years, thismakes it critical to ensure that reliability tests have been performed by the tracker company on the design. This could be achieved through either accelerated tests on the system or having reputed third party design reviews and certifications. Absence of these may pose a greater risk to the developer in establishing the tracker's suitability for 25 years. Analysis of performance data from a plant that is already using the productand feedback from existing sites are other important factorsto consider in order to establishperformance credibility.

6. **Local Service and Spares Availability**

   A solar power plant is generally designed to function for a period of minimum 25 years. This is possible only when the maintenance activities are timely and carried out even beyond the usual warranty period of 10 years. A well-established company with a strong financial backing, known for its integrity and locally stationed service personnel would be crucial in reducing downtime and extracting maximum performance during the entire service life of the plant. Presence of manufacturing/assembly units in India would also be crucial to ensure quick supply of spare parts and to save additional money spent on custom duties.

Conclusion

Selection of a tracker involves a holistic consideration of multiple technical and commercial aspects over the entire lifetime of a plant. The difference between the upfront cost and the cost incurred during installation could be as high as INR~11 lakhs/MWp if the tracker design is not selected appropriately. Thus, rather than having a myopic look at just the offer price, it would be prudent to look atthe overall cost. It is also important for developers to analyse ease of installation, ease of maintenance and reliabilityto ensure they reap maximum benefit of the tracker system.