Mr. Manyam,
Regional Manager,
South India, Azure Power O&M Team

Optimization of a Solar power plant's performance by creating an alert / alarm on DC section

There is no benchmark / reference considered for defining the healthiness of the DC connected load represented neither by the SPV module nor by the string. Moreover, the man hours to monitor whole of the strings in a solar power plant would be huge which could be invested in further maintenance activities for efficient operation of the plant.

In most of the solar power plants in India the DC load connected to the inverter primary end (on the end of inverter input) is being monitored manually by means of a clamp meter, measuring the string as well as the main outgoing cable current as a whole from the string monitoring box.

1. While measuring the string current individually, the imbalance between two consecutive strings observed is considered to be the intimation of fault / unconnected load at that particular string; further that string's each solar photo voltaic (SPV) module will be monitored with the help of IV curve generator/tester and the status of operation of the panel will be known.
2. Alongside during the measurement of current in the main outgoing cable from each combiner box, the imbalance between the negative and positive cable's current is considered to be the indication of unconnected load / fault in that particular DC section.

In both of the cases mentioned above there is no benchmark / reference considered for defining the healthiness of the DC connected load represented neither by the SPV module nor by the string. Moreover, the man hours to monitor whole of the strings in a solar power plant would be huge which could be invested in further maintenance activities for efficient operation of the plant.

There is a need of benchmark to be defined within a plant for justified plant performance especially on the DC end in particular to the plants with no monitoring at the string end for each instant of operation during generation hours.

The parameters that are to be considered for framing a formula for particular inverter are as follows:

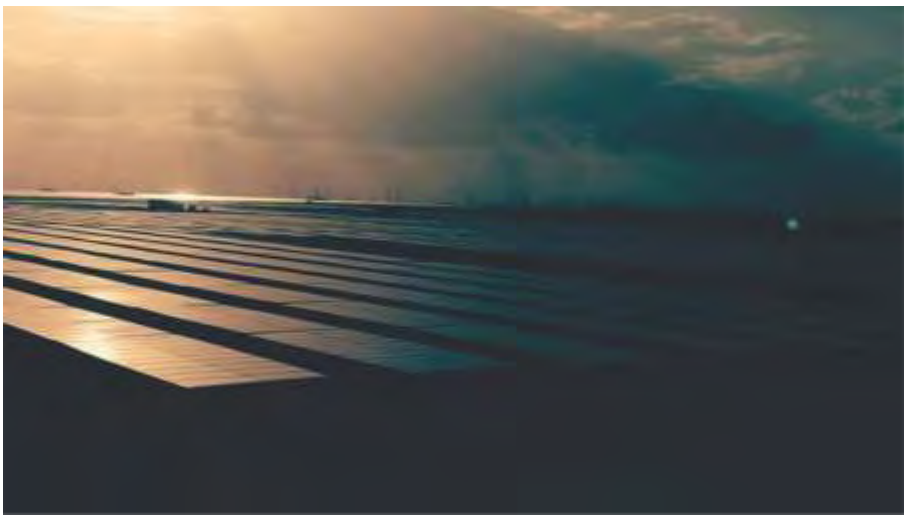
- Actual DC connected load on the inverter
- DC input to the inverter (.CSV file)

The DC input to the inverter will be punched in the CSV file at each 15 minutes of interval, so the average value of 4 of such data punched shall be considered to avoid short duration mismatch in solar irradiation / insolation. Then the ratio of the DC input power to the DC connected load shall be calculated. As is the process of defining the benchmark for DC section within a plant, the maximum of such ratio to be considered as the reference. The grievance observed from inverter to inverter shall be considered as the degradation / fault / unconnected load in means of a SPV panel / string on the DC end.

The calculation in brief could be framed as formulae as follows

$$\text{Max}\left(\frac{\text{DC input to inverter}}{\text{DC connected load}}\right)$$ among all the inverters with in a plant

$$-\left(\frac{\text{DC input to inverter}}{\text{DC connected load}}\right)$$ of a particular Inverter



Whenever there is a grievance of at least 1% observed then the alarm of fault / unconnected load on the DC end shall be raised. This formula can be defined in any of the computer language / algorithm with the help of IOT as available at every plant in India for monitoring the inverters, switch gear etc. The following are the key considerations that are to be followed prior

- DC connected load shall only be considered for similar SPV panel capacity
- Inverters with similar SPV panel capacity shall only be compared for grievance
- Grievance alarms shall not be raised during the initiations hours and closing hours of generation each day, so as to avoid the false alarms

Conclusion

1. The considered procedure will optimize the manual effort of personnel at a SPV power panel.
2. Even such development will optimize the plant's performance by the way of optimized Mean Time to Repair (MTTR).
3. Such optimized MTTR will lead to increases generation and obviously the efficiency i.e., the Capacity Utilization factor (CUF) of the plant.