Flood risk assessment for utility scale solar PV plants

By

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EXECUTIVE SUMMARY

No one can control floods, but yes, it is possible to control the damage to solar PV plants due to them. The destruction of solar PV plant components largely depends upon the flood volume, velocity, duration and depth. Here are a few of the flood consequences on solar PV plants:

- Plant may get completely submerged and thus damage can set in.
- Module mounting structure (MMS) foundation may settle down because of soil erosion or water logging.
- Corrosion may accelerate resulting in damage of MMS posts.
- Underground cables and cables present in control and inverter stations may submerge in water amounting to high plant downtime.
- In case of huge water pressure, boundary wall of plant may collapse.

To avoid all such situations, it may be essential to conduct an in-depth hydrology study during the project planning stage, as we believe in 'Prevention is better than Cure'. The study considers flood occurrence, distributions and water movements. Next, it is required to consider technical aspects for flood water treatment, in case, there is a flood situation due to unavoidable reasons, like inaccessible location or others; then this helps treating the affected plant components effectively and minimize the losses.

SgurrEnergy is known for its thorough and practical approach towards conducting hydrology studies for large utility scale solar PV plants; our team is proficient at identifying all the possible associated risks and coming up with effective mitigations well before the project gets into execution phase. This study helps the project stakeholders to cater a feasible and an economical solution.

INTRODUCTION

A **flood risk analysis** is a beneficial procedure before solar plant installation. However, it is advisable to hire technically educated and experienced professionals who can ensure accurate mathematical calculations for flood prevention at a given site. Flood can be of many types; they may be broadly classified as river flood, flash flood, ground water flood, sewer flood and coastal flood.

Investors should take a look at all the conditions and emphasize on **drainage assessment** in order to avoid the future troubles. **Hydrology studies** essentially play a pivotal role at odd sites, which are prone to frequent floods. The study reveals all the possible outcomes and its prevention techniques before the actual arrival of flood.

TYPES OF FLOODS AT A GLANCE

River flood: When the solar PV plant is located near a river, then there is a possibility of floods as heavy rainfall can lead the river to cross its limit and overflow the banks.

Flash flood: In case of heavy rainfall, it becomes impossible for ground and drainage system to absorb water quickly. The water then drains in the area of solar plants and causes damage to its components.

Ground water flood: Prolonged rainfall causes saturation of ground, which means the ground is incapable of absorption of extra water. Thus, the excess water raises the ground level and results in flood in PV plant area.

Sewer flood: This situation arises due to a blockage in sewer. But usually the PV plants are built in remote areas, hence the possibility of sewer flood is comparatively low.

Coastal flood: Situations like low tides, high tides or tsunamis cause major damage to PV plants situated near coastal areas.

NEED FOR EFFICIENT DRAINAGE SYSTEM

It goes without saying that an efficient drainage system can handle the flood water effectively. In case of any fault in the natural drainage, artificial drainage systems can be provided for water management. Another solution is to clean or widen the natural drainage and improve its performance and efficiency. It is important to remember that proper functioning of natural or artificial drainage depends upon the site topography.

Below mentioned are some conditions which further worsen the drainage situation:

- Low level of site as compared to neighboring locations
- Huge watershed area in nearby location
- Shallow ground water table
- Impermeable soil
- Steep slope of land

In few of the conditions even mechanical de-watering may be of limited use.

ALTERNATIVE WAYS OF BYPASSING FLOOD WATER

In case the drainage system is not a feasible solution for any site, then an alternative way is to channelize the excess water from the outside of plant boundary. If the site topography does not permit this, then one can restrict the water entry inside plant through an effective retaining structure. At times, it may be required to forcefully drain off water using water pumps.

It may be note that channelizing water or restricting it outside the plant premises may create social issues. In addition water channelizing or construction of retaining structure may require huge capital expenditure; hence it is important to make a choice between:

- Channelization
- Diversion of water
- Design the solar plant components by keeping in mind the flood impact on them.

DAMAGE ON PLANT COMPONENTS DUE TO FLOOD

Flood can cause a substantial damage to PV plant components. Components like PV modules, DC cables and electrical equipment may not be covered under warranty in such a situation. Floods may lead to in shutting down of plant / inverter section which resulting in a revenue loss.

Below mentioned are the damages that may affect the plant components.

PV modules: Due to submergence of PV modules, floating debris can cause damage to PV modules. In such situation module replacement may be required.

Cables and electrical equipment: DC cables are not designed for submerged conditions, in this condition the isolation resistance dips to the lowest leading inverter tripping and plant shutdown. Huge capital, efforts, and time may be required for cable replacement.

Structure foundations: Water logging can cause settlement of foundation. In such cases, cohesive soil will cause more damage as compared to non-cohesive soil. Recovery from such situation requires dismantling of table which is a time-consuming task.

Accessibility: Heavy flood may hamper the accessibility which means that it will become difficult for technicians to approach plant due to water logging.

Steel posts and foundations: Erosion of foundation and corrosion of steel post may happen because of excessive water. Usually zinc coating is applied at the corroded segment of post and additional concrete is applied to the foundation.

Boundary Walls: Excess water may damage boundary walls. This may cause huge damage to property and livelihood.

Warranty: PV plant component which are not designed by considering flood will void the warranty.

SGURRENERGY APPROACH

SgurrEnergy has years of experience is assessing flood risks for large utility scale solar PV plants. Our team is capable in making precise computation for generating an optimal solution during pre or post construction. We are here to make our clients aware about the possible consequences of floods at their site and the best solution for the same.

SgurrEnergy considered rainfall and topography to be the key parameters for commencing hydrology studies. Rainfall information is preferably collected from meteorological stations, but in absence of meteorological data, statistics from TRMM (Tropical Rainfall Measuring Mission) are used. Information measure for ground elevation in the watershed area is considered quite accurate. However, in case of unavailability of such data satellite based SRTM (Shuttle Radar Topography Mission) with 30m resolution can be a good assumption. Other factors that may be assessed for flood risk analysis are ground water table, soil properties, land cover etc.

SgurrEnergy typically uses industry known tools like HEC-RAC, HEC-HMS, QGIS and Civil 3D for flood analysis; this computes the flood volume, distribution, depth, and velocity of flood; basis of which internal drainage system or diversion or restriction of flood water from the plant premises and impact of excessive water on plant components are planned.