CASE STUDY

Genius Tracker TF™

Revolutionizing Solar Installations with Challenging Terrain

Introduction

Utility-scale PV solar plants with single-axis trackers are increasingly being installed on sites with extreme slopes, undulating terrain, and other challenging site conditions. Combined with rising labor costs for grading work, these conditions risk increasing the cost of developing PV plants.

GameChange Solar's Genius Tracker TF™ (Terrain Following) dramatically reduces or eliminates the need for tracker-specific grading by adapting to the natural contours of the land. This not only cuts civil construction costs but also minimizes environmental impact, making it an ideal solution for high-performance solar projects on undulating or irregular terrain.

Genius Tracker TF Reduces Grading and Steel Costs

Historically, tracker systems have consisted of long, straight tubes installed along a single axis. While the entire table can be installed at an angle to better match overall ground slopes, this single axis cannot account for undulation of the terrain beneath the table. Straight-tube trackers can require extensive grading and pile reveal to level out any pre-existing undulating site terrain as shown in Figure 1.

Figure 1: Straight-tube trackers requiring grading and additional pile reveal to account for site terrain.

Genius Tracker TF removes this constraint by allowing the torque tubes within a table to flex, following any undulations of terrain beneath them. As shown in Figure 2, Genius Tracker TF tables are not constrained to a single axis but instead follow the slope of the ground below them. This can reduce or eliminate the need for site grading underneath the tracker tables.

Figure 2: Genius Tracker TF tables following site undulations.

Genius Tracker TF allows for changes in tube slope of up to 1.7 degrees between each pile. This flexibility of the tube reduces pile length and grading compared to a straight-tube tracker, as shown in Figure 3. This system can be used on sites with extremely challenging terrain, prohibitively expensive grading costs, or severe constraints on gradable area.

To achieve these changes in tube slope, modules are spaced farther apart to avoid damage when the tables turn. This larger spacing is achieved with specialized purlins, resulting in nominally longer tracker tables.

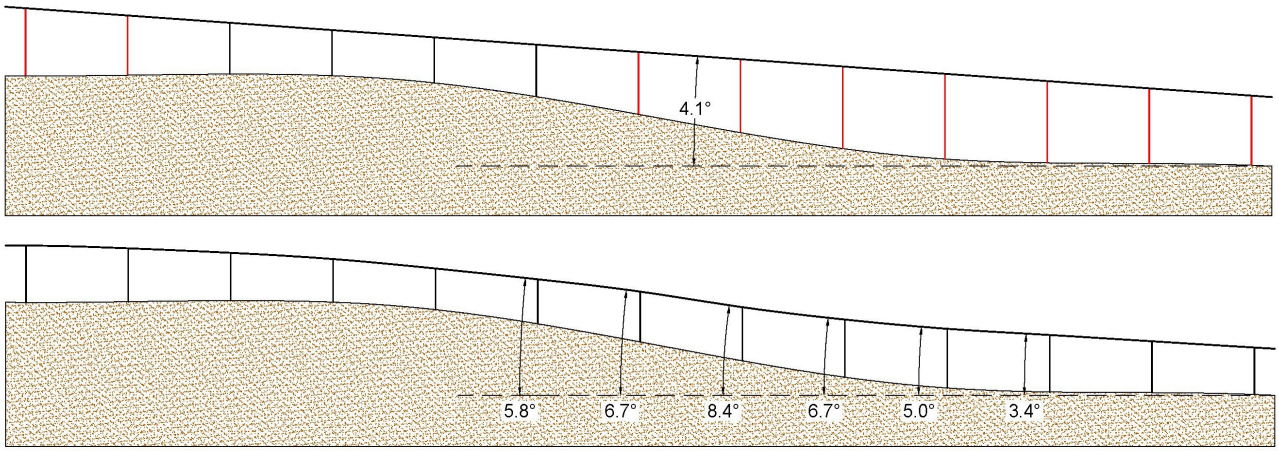

Figure 3: The straight-tube tracker (above) would require grading or additional steel in the area marked with red piles. Genius Tracker TF (below) covers the same area with no grading or extra steel needed.

Compared to a straight-tube tracker, Genius Tracker TF reduced graded volumes by 87% for the terrain-challenged site in the following case study.

CASE STUDY

Initial conditions

Genius Tracker TF was compared to a straight-tube tracker for a 124.7 MW site in Kentucky. This site consisted of 3,205 tracker tables across 586 acres of buildable area. The two tracker systems were modeled according to the specifications in Table 1.

	Straight-tube tracker	Genius Tracker TF
Maximum Overall Slope	15%	15%
Pile Reveal Window	12" [30 cm]	12" [30 cm]
Change in Tube Slope per Pile-to-Pile Span	0°	1.7° *
Maximum Slope Difference between Table Center and End	0°	5°

Table 1: Terrain specifications of straight-tube and Genius Tracker TF trackers.
** Assuming a 30' (9.14 m) span*

Grading Analysis

A grading analysis was performed for each design to determine the required volume and locations of grading across the site. The grading analysis is performed according to the steps below.

1. Create a mesh of tracker pile coordinates, linking piles to their nearest neighbor in the north-south and east-west directions.
2. Track slope between adjacent posts and perform cut-fill operations until slope limits are met.
3. Track post reveal heights and perform cut-fill operations in areas where the reveal height is exceeded.
4. Compute east-west slopes around the tracker tables to identify and mitigate areas of terrain-induced wind effects.
5. Recompute post heights in affected areas and rerun the above analysis based on new slope and post reveal heights.

The cut volume and fill volume in each project parcel are analyzed separately and balanced to minimize large discrepancies. This outputs both the total cut and fill volumes, as well as the areas of required grading.

Results

The total volume of cut and fill for each design is shown in Table 2. For this project, Genius Tracker TF reduced grading volumes by 87%.

	Straight-tube tracker	Genius Tracker TF	Reduction Achieved
Required Cut	200,700 yd^3 [153,466 m3]	25,248 yd^3 [19,303 m3]	87%
Required Fill	196,917 $yard^3$ [150,554 m^3]	25,588 yd^3 [19,563 m^3]	87%

Table 2: Cut and fill volumes for straight-tube and Genius Tracker TF trackers. Genius Tracker TF saved 170,000 yd^3 (130,000 m^3) of cut and fill volumes.

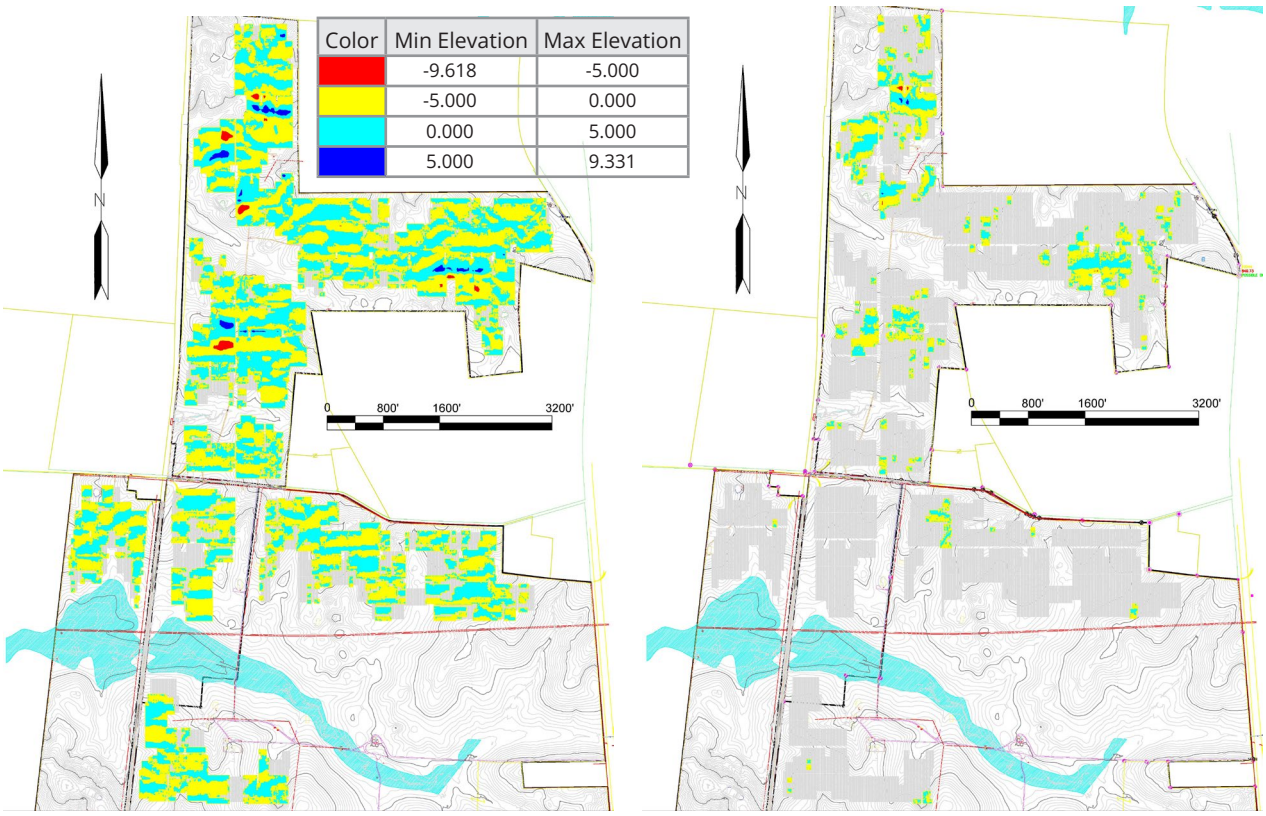

Figure 4: Straight-tube design graded area (left) compared to Genius Tracker TF design graded area (right).

Areas of required grading are shown in Figure 4. While the straight-tube tracker would need grading to be performed across the vast majority of the site, Genius Tracker TF only needs minimal grading in localized areas.

Conclusion

This study highlights the Genius Tracker TF system's ability to reduce grading and steel costs for sites with challenging, undulating terrain. For a 124.7 MW site in Kentucky, Genius Tracker TF reduced grading volumes by 87%, resulting in a more cost-effective and bankable design. This system can be used to ensure projects are successfully designed and completed despite complex site conditions.

Benefits of Genius Tracker TF

- ✓ Dramatically reduce or eliminate site grading
- ✓ Cut civil costs and steel usage
- ✓ Build on steeper slopes, undulating terrain, challenging site conditions
- ✓ Speed up permitting with less environmental disruption
- ✓ Maintain high tracker performance on sloped or undulating sites

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