Surveying the scene

Surveying | All parts of the PV supply chain are under pressure to reduce costs and boost the competitiveness of solar. A new rover vehicle developed for site surveying work promises to help significantly reduce labour costs in the construction of large-scale solar projects. Danielle Ola reports

TerraSmart, a Florida-based provider of turnkey ground-mount PV solutions, has introduced the US solar industry's first fully autonomous precision survey rover (ASPR) to perform survey stake-out functions. The robot, which is a gas/electric hybrid, more than triples survey speed and accuracy, and is scheduled to be followed up by a larger model with added drilling capabilities. TerraSmart Systems design manager Chase Anderson caught up with *PV Tech Power* to discuss how the rover will revolutionise the game.

What exactly is the rover and what it does?

The APSR was designed and built not to replace a human surveyor, but to give them a more accurate and a faster tool to do their job with. It's a machine that locates on a large field exactly where all of our foundation products need to be installed. It does this completely autonomously using various algorithms and high-accuracy GPS technology. The purpose of it was to speed up what traditionally is one of the slowest parts of the installation of a solar project.

When designing the robot to be used as a tool, we had to make sure that they didn't sacrifice any of that reliability and accuracy and it turns out that we ended up with a machine that can be more accurate and more reliable than a human can.

Why specifically is this a useful technology for solar?

There are many industries where survey is used, but in solar specifically, you have thousands and thousands of foundations in a grid-like pattern just due to the sheer scale of these projects. We've done projects with over 100,000 foundations that have had to be manually surveyed for each and every single one of them. So you can imagine the benefit of a machine that could do that for us, both quicker and more accurately.

In solar specifically, it is such a good application because of the sheer quantity. Any type of solar installation has – even the small projects – thousands of foundations. The average-sized projects have anywhere from 5-20,000 foundations and the really big ones have over 100,000. In our day, we have to locate thousands of points underneath the solar panel; and that is a common thing with all solar companies and all solar products. It helps us get our job done better and faster with less possibility for error.

How significant are the speed and accuracy you describe in cutting overall project construction costs?

When we can survey more points in a day, it still only takes the one man to do it; so his eight-hour day is now four times more efficient, so there's a little bit of cost reduction there in labour alone.

The robot has different attachments, and one of them is a micro-drill that will drill a small hole into the ground, and we call it the pilot hole. When there's a pilot hole, the team that are installing the ground screws behind the survey robot can use the pilot hole to install the ground-screws easier and faster, which can also reduce the cost.

The biggest savings are on the really large projects. When we know that our survey is going to be reliable, we know that our foundations are going to be in the right place, the installations of the solar racking becomes so much easier because it is more precise from the get-go. When things get easier for field crews who can start to be more efficient, not just in the survey but in the ground-screw installation, in the racking installation, the electricians have an easier time putting the modules on, just because everything fits together better.

How much difference does the APSR make in reducing the levelised cost of electricity in projects?

I don't think that I have a good answer for that one. We've just recently released it; we've used it in a couple of places here in the north-east, but it's a little too early to tell exactly, to put a hard number to it.

What sort of demand have you experienced for the vehicle and what sort of wider uptake do you foresee?

It is currently just available in the States. We've had interest from clients in the north-west US such as Nevada, Oregon and California, and we have a very large footprint in the north-east. We are very excited to be not only using the three that we currently have, but building more to meet the demand in both sides of the States.

We have deployed three but they are booked up for a while for TerraSmart use so that's why we are busy on developing more. Our goal is to move towards a system where we are using this on every single site, just for consistency. So we would like to have one for every single survey team that we have.

What would you say the limitations of the APSR are at the moment – whether that is in terms of terrain, speed, inclines and so on?

So we designed it to handle up to 45 degree slopes, so there are not too many challenges in terms of moving up the side of a steep hill – that was a key design consideration. So far, in all the sites and the testing that we've done, it has run extremely well in all conditions.

But as with any GPS technology, when there's too much cloud cover or a really terrible storm, you will lose that signal from the satellite. That's certainly a limitation but typically on days like that, not too much is happening anyway, so it's not too big of a loss.

The tyres that are on the machine are designed to work in the snow. We have yet to run it during the winter season, but we are pretty confident that it will work. And if doesn't, the tyres can be swapped out for tracks within a few moments.

What is the application like for considerably larger PV sites i.e. 100MW+?

One operator has the ability to control multiple units from a single handheld device using long-range wireless communication. On a large site, say 100MW, we would definitely be able to run not just one but maybe three or four units at the same time and guarantee that our robots are well ahead of any phases that are starting after it.

Based on the velocities that I've seen, I would put two on a 100MW site; on some of the previous larger projects that we've done that had very compressed timelines, we were already behind schedule and we had to finish sooner. But realistically, on a traditional timeline, one would have been more than enough to support the standard course for 100MW. If we need one, we can send one, if we need two, we don't have to send any more people; we just send another robot and one person can do both.

What other results can you share from the field?

We've done trialling on multiple sites. We sent a survey crew behind the robot to verify on these sites that it is putting in accurate, reliable foundation locations – and every single time we were unable to locate any that weren't correct. It kind of has a fail-safe in the software that will move the robot into the correct position and only when the robot is 100% certain, based on all the sensor data, will it allow that point to be placed. And if at any point during the placement the robot detects that it has moved, or some environmental condition has changed, it will redo that point; or it will mark that point as incomplete and the operator can choose to come back at a later time.

TerraSmart's ASPR is claimed to be able to stake out the foundations for large PV arrays in a fraction of the time it takes humans

A lot of the numbers that we've posted thus far have been based on our official stats. My survey crew can view between 200-250 survey points in a day accurately. They certainly can do more, but we usually see a loss of accuracy if they do that. The APSR has proven to do over a thousand and in one case, what was just over 1,200 points within the same amount to time; and of course the accuracy…

What attributes are going to be improved on the new model, other than size?

We are going to scale up – and the reason for this is to build a machine that not only can survey but can rock-drill at the same time. A lot of the projects that TerraSmart does are in locations where right beneath the grass or the top level of dirt is solid rock. So if we have a quicker, more accurate, more automated way to drill the holes that we need through that solid rock, installation times of our entire process will be greatly, greatly reduced. What used to be three phases will be down into one phase; survey, locate and rock-drill all the points of our sites for us. We usually drill between a six to eight-foot hole, with a diameter anywhere from three to five inches for our foundation product. That will now be automated.

The bigger model will also have eight wheels and those wheels will also be interchangeable with tracks. It is quite a bit bigger; not only are there eight wheels, but the wheels are almost twice the size. It will be at least six times the size of the current APSR.

Do you see any other applications for the APSR beyond site surveying, such as operations and maintenance?

I've never really thought about the O&M side – but I'm sure we can spin our wheels a little bit to come up with something.

Our guys have the ability to use the robot when it is not surveying as a tool to aid them in their construction; and we have incorporated a few things on the robot to help this – things as simple as a trailer hitch. You would be surprised how many times we need to move a small trailer from one side of a muddy site to the other and your typical truck can't make it through. So your APSR is both heavy and rugged enough to tow the trailer from one end of the site to the other. We actually can use it to move material around if needed; and you can take manual control of the robot to do that.

In addition, the entire front assembly – I call it the attachment – is interchangeable and designed to work with the pilot hole drilling attachment that I mentioned, we also have a spray paint application. It can mark and spray points on the ground and another one will clip flags in the ground.

We can also use the robot to drive over an empty field and create a topography map using the on-board sensors. Before a project starts usually they'll send a surveyor out to use GPS equipment and make a 3D model of what the terrain looks like. We can actually run the robot in a grid pattern across the same field and produce the same result and we can create this really nice 3D terrain model that be used by engineers to make the shading plans and the various solar installation layouts more efficient. ■