

Project briefing

WORLD'S LARGEST FLOATING SOLAR PROJECT: MAKING USE OF THE UNUSABLE

Location: Huainan, Anhui, China

Project capacity: 40MW

The technical feasibility of floating solar PV and its long-term durability have often been questioned, but this year's commissioning of a giant project on a lake in eastern China has launched the technology into the global spotlight. The 40MW plant boasts an unprecedented scale and makes use of traditionally redundant, flooded mining territory. Major PV inverter manufacturer Sungrow Power Supply Co developed, built and owns the project in Huainan, south Anhui province. The firm has demonstrated that such plants can be constructed efficiently and connect to the grid in the first instance, but investors will no doubt watch its performance closely in the coming years.

Floating solar power plants are becoming increasingly popular across the globe (see box, next page) with their ability to reduce water evaporation in many applications. Simultaneously, the cooler ambient air, resulting from the immediate proximity to water, particularly in hot and humid environments, limits the solar panels' exposure to the 'temperature coefficient' issue that can cause performance degradation.

The Chinese government has been strongly encouraging renewable energy programmes, says Xiao Fuqin, Sungrow's chief engineer of floating PV technology. The National Energy Administration (NEA) is now pushing the PV industry to participate in its Top Runner Project programme in which floating solar is included.

The Anhui mining region was chosen since the land was already heavily damaged, which made obtaining permits very easy. The depth of the lake also prevents it from being useful to commercial fisheries. "The whole point of this plant is to take high advantage of the min-ing ground which is already destroyed – and to help the environment," explains Cao Renxian, chairman and president of Sungrow.

The location also benefitted from being less remote compared to typical mining



regions. This helped with the logistics of bringing PV equipment to the project. In fact the biggest challenge only came after the long-haul transportation when Sungrow had to shift equipment from the shoreline onto the lake.

However, the flooded mining area is still sinking fairly rapidly. Its depth currently sits at around four to 10 metres, but it is expected to reach as deep as 15 metres in the near future, says Renxian.

Danger waves

Sungrow assessed the natural conditions of the project location before starting construction since not all water zones are suitable for PV technology. Variables included water velocity, wind grade, water area and wave height among others.

"Based on these environmental variables, we considered how the wind load, wave and water flow would influence the floating power station, so that we could guarantee the safety of the floating block under extreme conditions by carefully designing the anchoring system," says Fuqin. "If the wind grade or wave height of a certain water area goes beyond the safety estimation (e.g. large natural lake or sea surface), we would refuse to construct any floating power station over that water area."

Preventing large waves is perhaps the most obvious risk for an onlooker to

identify and indeed it remains one of the biggest risks even for experienced solar installers. Preventing damage to modules from humidity is critical but perhaps comes lower down on the priority list.

Floating tech

The floating systems are kept in place by multiple specially designed anchors. Meanwhile, flotation devices were provided Sungrow's Floating PV Technology subsidiary. Renxian says that unique floats for cabling also had to be designed. Furthermore, the effects of humidity and potential-induced degradation (PID) are major considerations given the proximity to water.

The project used modules from multiple Chinese brands. Major supplier JA Solar supplied its monocrystalline double-glass modules designed to offer greater protection against moisture ingress, high anti-PID performance and resistance against corrosion.

Renxian says the base of the floating systems should be carefully designed and resistant to fatigue. The systems therefore had to be tested and simulated many times before coming into real use. Even the distancing between each base had to be carefully simulated, particularly since the water will also be used for cleaning purposes. Renxian claims that Sungrow can promise at least 20-years of use on its



By Tom Kenning

floating systems and is also confident that the water cooling effect allows for higher energy production than on land.

While a lot has been claimed about the effects of water cooling on a module's output, Fujin is careful not to exaggerate, adding: "The cooling effect has been proved to be helpful for increasing module generating capacity. All comparisons up to now are based on assumptions; after our pragmatic verification, we think the increasing of module efficiency would not reach 10%."

Sungrow's SG2500-MV central inverter solution was deployed at the floating plant, featuring the integration of the inverter, the transformer and the switchgear, as a turnkey station. In addition, the combiner box SunBox PVS-8M/16M-W supplied by Sungrow was customised for a floating power plant's applications, enabling it to work in a stable condition in such an environment with high levels of humidity and salt spray.

Most significantly, this was also the first time that a central inverter had been used in a very large, utility-scale floating solar plant. "A lot of the equipment in this PV plant, including the central inverters and transformers, are all actually floating above the water, so not only the module set that everyone can see but most of the core equipment," explains Renxian. "In this way we can save a lot of cable use."



Sungrow also set up its own transmission lines from the floating matrix to the booster station and then to the grid-connection point. Power from the project is also being sold to utility State Grid Corporation of China (SGCC).

"The banks are willing to provide us financial support because even though the ROI of these floating plants can be a little bit lower than the other ground-mounted PV plants, this kind of plant doesn't have a real estate problem," adds Renxian. However the firm has not given any indication of the overall costs of the investment.

O&M on water

The number of construction employees working on site at any one time oscillated from between 90 to 150 people. Meanwhile, around 20 people are assigned to performing the operation and maintenance (O&M) of the equipment, with regular water area weeding and panel cleaning required.

Rather than water being a hindrance to effective cleaning of the panels, Fujin says that the power station itself being afloat on water can be used to the O&M team's advantage. Water is of course readily available and can be easily collected for cleaning purposes. For this to work though, Sungrow had to design in at early stages an O&M dock, laneway and pedestrian path; in other words there are specifically sized gaps between the bases to allow for water collection and access. However, there is generally less dust on these floating systems than ground-mount projects so even the necessary frequency of cleaning is reduced.

"We have equipped the project with a complete monitoring system," Fujin adds. "By equipping different kinds of automatic alarm monitor facilities such as cameras, GPS system, dip angle monitor system and water level monitor system, we can increase the efficiency and facilitate the troubleshooting progress."

Renxian says that robotics will also be



used for some of the cleaning process, but has not provided any more detail.

Another world record

While a 20MW floating system in the same Chinese region had been the largest operating plant since early 2016, and as if the 40MW giant wasn't enough, Sungrow is already well under way in building another 150MW floating solar project in the same area. This will again be the world record in terms of capacity on completion, which is expected before year-end.

"The on-site booster station and delivery circuit of the power station is about to be complete, and the construction of the over-water part has already started," explains Fuqin.

Future floaters

The lessons learned from such enormous projects are manifold and will pave the way for Sungrow to establish itself as one of the top floating solar players going forward.

"By continuously summarising, adjusting and perfecting our blueprint, we successfully made our project more practical, safe and economical," says Fuqin. "Also, we have collected and studied much experience in the aspect of construction, and these experiences could help avoiding detours in similar future projects, increasing efficiency greatly."

Looking worldwide, he believes that all countries with abundant solar resources and suitable water areas would have good potential for floating solar systems, such as many Southeast Asian countries, as well as Japan and India. Indeed, Sungrow is hoping to offer its complete floating PV knowledge worldwide, having learned key lessons from its initial projects. It already has interest from customers in Japan and Southeast Asia with its offering of a total solution including the integration of the base and the inverter on the floating system.

Exponentially increasing activity on other floating projects across the globe suggests that this segment offers a huge opportunity for the solar industry and governments that are lacking in available land space. ■

Floating solar sets sail

The completion of Sungrow's system has coincided with the announcement of a number of other innovative floating solar projects:

Ciel & Terre starts building 70MW floating PV project with LONGi mono modules

France-based floating PV specialist Ciel & Terre (C&T) International has commenced construction of a 70MW floating solar plant for Chinese state-owned developer CECEP on a clay quarry lake in Anhui Province, China. Once complete it could be the world's largest floating solar plant, but only briefly, because Sungrow is also due to complete its 150MW floating plant before the end of the year. C&T's 70MW project will include monocrystalline modules from Chinese manufacturer LONGi Solar (formerly Lerri Solar). Central inverters will be put on stilt platforms on the shoreline of the quarry lake so as not to interfere with neighbouring farm activity.

Hanwha Q CELLS developing 80MW rotating floating solar project in Korea

Hanwha Q CELLS has signed an agreement with Korea Hydro & Nuclear Power (KHNP) to build an 80MW rotating floating solar project on a reservoir in South Korea, which would be the largest of its type in the world. Hanwha Q CELLS Korea would be responsible for supplying the PV modules for the project, while EPC work would be carried out by Hanwha Solar Power under Hanwha Chemical in collaboration with Korean floating solar specialist Solkiss. Solkiss had developed a solar powered rotating technology for a complete floating solar system, acting like a conventional single-axis tracking system, generating up to a further 20% in electricity generation.

Korea Rural Community Corp. to develop 280MW floating PV portfolio

The Korea Rural Community Corporation intends to develop a 280MW portfolio of floating PV systems in South Korea. The portfolio will feature three PV systems that will be developed in three man-made lakes located across the country. The three installations will be located in South Chungcheong and South Jeollanam provinces – featuring a pair of 100MW projects and an 80MW site in Goheung county. The three installations are expected to be completed by 2019.

Floating solar pilot projects in the Netherlands set sail

A Dutch consortium of government agencies, R&D facilities and solar companies have launched two of four pilot floating solar projects on the Slufter on the Maasvlakte, a water region used for contaminated harbour dredging sludge. The four different floating solar pilot projects will be overseen by the National Consortium Zon op Water (Floating Solar), which includes ECN and TNO working together in the Solar Energy Application Center (SEAC) and is aiming to demonstrate the feasibility of floating solar in rough water conditions. Two systems were launched on the Slufter on July 14 from Texel4Trading and Wattco, which has partnered with France-based floating solar pioneer, Ciel et Terre, using its 'Hydrelío' system. The two other pilot systems from Sunprojects and Sunfloat are expected to be launched in the same stretch of water soon. Subject to the trials, plans could include 100MW of floating solar systems on the Slufter.

Istanbul municipality launches first floating solar plant in Turkey

The first floating solar (FPV) power plant in Turkey officially became operational on 4 August 2017 as part of a testing phase that could lead to a significant number of systems installed by the Istanbul Metropolitan Municipality (IBB) on reservoirs, lakes and dams. Istanbul Water and Sewerage Administration (ISKI) with Istanbul Energy commissioned the 250kW testing system, located on the Büyükçekmece lake, near Istanbul, deploying a total of 960 multicrystalline (60-cell) modules of 260W (STC). Two separate FPV systems are being evaluated.

First ever hydro-electric and floating solar project operating in Portugal

Ciel & Terre International has collaborated with Portuguese energy firm EDP (Energias de Portugal) Group to design and build the first floating solar project at an existing hydro-electric power station at a dam located at the mouth of Rabagão river in Montalegre, Portugal. Working with EDP subsidiaries, C&T developed a 220kWp floating solar power plant, using 840 solar modules on its 'Hydrelío' mounting platform, occupying an area of around 2,500m² and cost around €450,000. The pilot project was initiated by EDP back in 2015 and has been operating since the end of November 2016. C&T expects the plant to generate 332MWh of electricity in its first year.