

Project briefing

ADANI OVERCOMES BIBLICAL FLOODING TO BUILD A 648MW PV PLANT



Credit: Adani

Project name: Kamuthi Solar Power Plant
Location: Tamil Nadu, India
Project capacity: 648MW

Set across a semi-arid stretch of land in far south India, the world's second largest solar plant and India's biggest to date is a pertinent symbol of India's emergence as one of the most dominant renewable energy markets on the planet. Already under intense pressure to physically construct the entire project capacity in just eight months, heavyweight Indian infrastructure conglomerate Adani also had to withstand unseasonal and unprecedented extreme weather in late 2015. Incessant rain wreaked havoc for a full three months, flooding the site and almost bringing the construction process and equipment deliveries to a halt. Even after completion, legal issues over electricity tariffs and deadlines ensued, but the project remains a remarkable achievement, one that sets the tone for India's forthcoming 'ultra mega' solar parks.

Adani's project, located near Kamuthi in the Ramanathapuram district of Tamil

Nadu, required an investment of INR45.5 billion (US\$679 million) and around 8,500 workers. At 648MW it represented a significant step up from the previous record-holding plant, the 579MW Solar Star project completed in 2015 in California by SunPower for BHE Renewables. However, Adani can no longer lay claim to the record, following the completion of an 850MW solar project in the western province of Qinghai, China, in January 2017.

Land acquisition in Tamil Nadu took a long time and it was finished several months over schedule, says Tim Buckley, director of energy finance studies, Australasia at the Institute of Energy Economics and Financial Analysis (IEEFA) and a close observer of renewables in India. However, the learning from this endeavour around supply chain management and logistics will have filtered into the entire Indian renewable energy system. Now even the banks and financiers are beginning to understand solar, Buckley says.

In the midst of completing the Kamuthi project, Adani's energy-related ventures have attracted some controversy. The conglomerate is still pushing to start

mining operations at the Carmichael coal mine in Queensland, Australia. This is a mammoth undertaking, which has not only riled environmentalists, but has also got some economists scratching their heads over its feasibility. Indeed, Adani Power, part of the Adani Group, recently reported another net loss of US\$48 million in the three months through to December, putting it on track for its fifth year of enormous losses since FY2012, according to a report from IEEFA. Ironically, this is partly the result of coal imported to India losing market share to lower-cost domestic coal and ever more cost-competitive renewable energy sources, particularly solar, which has been on a steep downward trajectory since the end of 2015.

Nevertheless, reflecting on the Kamuthi solar plant, Gautam Adani, chairman of the Adani Group, said of the project: "This is a momentous occasion for the state of Tamil Nadu as well as the entire country. We are extremely happy to dedicate this plant to the nation; a plant of this magnitude reinstates the country's ambitions of becoming one of the leading green energy producers in the world."

Land preparation

To kick off the project, Adani had to level and grade large tracts of land. This was followed by plotting the land, using surveyors to mark the ground before driving in steel piles to support the modules. An office was set up on site along with a major lighting facility to allow for work through the night. At one point the developers had to drill 1,200-2,000 piles on a daily basis. The piles were tested by exerting a pressure of 1,200kg per sqcm to see if they would remain in place to indicate that they could withstand high wind speeds and other extreme conditions.

"As a solar power producer our land requirement is huge and you know land is not an easy task in a country like India which is highly populous," says Jayant Parimal, chief executive of renewable energy at Adani. However a site with high irradiation was found 90km from Madurai,



By Tom Kenning

an Indian city that houses the famous Hindu sanctuary known as the Meenakshi Amman temple.

The site not only provided enough space, but it was also easily accessible from the nearest port town of Tuticorin. Nevertheless sourcing a workforce and equipment from Kamuthi remained a challenge given that it is a remote agrarian and non-industrial town.

Imported equipment required large storage areas so Adani built an interior warehouse of 20,000sqm and an outdoor warehouse of 120,000sqm. Inverters required enclosed space, but the storage infrastructure was not ready in time for delivery so the management had to hire other space in Kamuthi town until the on-site warehouses were complete. They were not ready until mid-October 2015, giving the firm just seven months to complete the plant by the 31 March 2016 deadline.

Modules were mounted in clusters of 4-5MW each, with the overall site divided into five sections of different capacities. Modules from manufacturers in China, Japan and Malaysia and Italy were all used. Meanwhile, 144 pre-engineered buildings were made to house the 576 inverters.

Transmission and O&M

Industrial technology firm ABB was responsible for the design, supply, installation and commissioning of the project's electrification and automation systems, which included two 230kV and three 110kV outdoor switchyards to connect to the local transmission grid.

The entire 648MW plant is now connected with the Kamuthi 400kV substation, making it the world's second largest solar unit at a single location.

ABB was also responsible for the SCADA system operating the plant. "As such a big plant, the fluctuation in [power] will be actually affecting the grid operations," says Sumeet Sharma, Adani project head of protection and metering. "So in that case the grid operators will request us to maintain the power of the plant at a fixed output, so you need an

aspect in the SCADA system that will help you do that function."

Once the plant was close to completion, the team was even able to use the chance event of a solar eclipse to test out the capability of the plant to adjust to sharp fluctuations in power and respond to the requirements of the grid using the SCADA system.

"The challenge was that we had multiple suppliers of equipment; for example the relays, the inverters and all of that has to be validated with the SCADA system," adds Ahmed Khan, vice president, power generation ABB India. In some cases, the teams had to wait to get hold of the necessary equipment due to the various delays over the course of the project construction.

Israel-based robotic and water-free solar panel cleaning solutions provider Ecoppia provided its robots to Adani so that no water is required to clean the enormous plant in this semi-arid region. The robots are solar charged during the day before they start cleaning with soft-micro-fibre brushes mounted on rails. These automated systems can also be remotely monitored, managed and controlled.

Timelines and extreme weather warnings

Adani's engineers reached the site in July 2015 and the first batch of module and mounting structure containers arrived from China in late August. Modules started to be installed in October with a target of deploying 3MW a day with a necessary extra push as the deadline approached. Sections of the plant would then be commissioned gradually as the plant grew. However, later in October, monsoons from the north-east descended upon Tamil Nadu, hitting headlines across the world as flooding started to affect even the mega city of Chennai.

As the rains continued to make the land swampy and marshy, the daily installation rate reduced dramatically and targets started to be missed in most areas. The month of October saw just 1.6MW of solar modules set up versus the necessary 90MW. Meanwhile, just 10 inverters were set up against the target of 80 and zero houses for the inverters were completed against a goal of 20. November figures were equally glum followed by a full halting of work in December.

The local port town of Tuticorin was hit



Credit: Adani

Ecoppia Kamuthi uses the waterless, automated cleaning system produced by Israel's Ecoppia



Credit: Ecoppia

heavily, cutting off the supply chain to the plant, since the port was due to receive more than 6,000 containers from around the world including from Taiwan, Malaysia, Italy, China, Israel, Germany, Turkey and Switzerland.

With four months to go, an emergency meeting was held at Adani corporate offices since logistics had become the hardest challenge. The firm needed to unload 100 containers per day so it started unloading containers simultaneously in four segments and even cranked up operations to 24 hours a day instead of the intended 12 hours. Workers were also put into three separate shifts.

From the initial 3MW daily requirement, the team now had to install between 10-12MW per day, which is the equivalent of around 40,000 modules. The project timeline slowly started to recover with the team installing 163MW in January against the 126MW target, such was the upsurge in efficiency of the workforce. However, engineers were still lagging by some way with inverter installations.

Officials from Tamil Nadu Generation and Distribution Corporation (TANGEDCO) started doing preliminary checks on the site and power was able to be evacuated from at least portions of the site. By the commissioning deadline, electricity from 360MW of capacity was already being exported to the grid.

"The size of 648MW in eight months was unimaginable for anybody," says K.S Nagendra, the Kamuthi project director. "When we landed at site and realised the magnitude of the work we needed to do, we thought we had bitten off more than we could chew. During the monsoon we

were in a shambles to reach our target by March – we really lost hope to reach there. In future we will see that proper pathways and drains are made so that rain gets into local drains and ponds."

Tariff dispute

Even after commissioning, the troubles did not end. In November 2016, the Tamil Nadu Electricity Regulatory Commission (TNERC) rejected Adani's call for a revaluation of the tariffs it is set to receive for the Kamuthi plant.

PV projects commissioned in the state before 31 March 2016 were due to receive a tariff of INR7.01/kWh (US\$0.103) from TANGEDCO, but this would go down to just INR5.1/kWh for any delayed projects.

While 360MW of Adani's project was commissioned before the deadline,

288MW were delayed following grid connection issues. This delayed capacity was completed by Adani subsidiaries Kamuthi Solar Power (216MW) and Ramnad Renewable Energy (72MW), but both entities also filed appeals to TNERC, claiming that the cyclone and heavy, extended rainfall in the region caused significant damages and delayed project execution. Both companies also claimed they had actually completed the projects ahead of the deadline, but the necessary substations had not been provided by TANGEDCO resulting in completion after the deadline.

Nevertheless, the Adani project will receive the lower tariff after TNERC rejected the appeals. Kamuthi Solar Power and Ramnad Renewable Energy have also filed pleas as a Dispute Resolution Petition, which will be taken on at the tribunal.

Despite the troubles, Adani has continued to show strong intent worldwide with significant project plans in Australia. Furthermore, Parimal says: "We are exploring the possibility of setting up PV plant in Bangladesh. So it is still in conceptual stage. Nonetheless we are very keen."

An Adani entry to neighbouring Bangladesh would be "a truly transformative investment proposal", adds Buckley.

Reflecting on the legacy of the Kamuthi project, Gautam Adani says: "India is one of the fastest growing economies and energy is a crucial part of growing economic development. To meet this surging demand solar is the best form of energy. India has tremendous scope for generating solar energy and it is high time we concentrate more on conservation of resources." ■



Kamuthi in numbers

- 380,000 foundations
- 2.5 million solar modules
- 27,000 MT of structures
- 576 inverters
- 154 transformers
- 6,000km length of cables
- 1,012 hectares of land

Credit: Adani