Kathu CSP plant in-sync with energy needs

The recent synchronisation of Kathu solar power plant to the national grid means South Africa is slowly but surely on its way to meeting government's plan to install 1 200 MW of concentrated solar power by 2030 as well as raise the installed capacity of renewable energy to 20 000 MW in the same year. *Phila Mzamo* reports.

The 27 energy agreements signed with power producers by Energy Minster, Jeff Rhadebe, early last year – at a total cost of R56-billion – will play a significant part in alleviating the pressures on South Africa's national grid, whilst combating atmospheric carbon pollution in the country.

One of these projects, the 100 MW greenfield Kathu solar power plant, situated in the Northern Cape Province has reached a critical milestone in the construction project, by successfully accomplishing first synchronisation to the South African grid. This milestone will propel the last steps before the plant starts commercial operation and reaffirm Concentrated Solar Power (CSP) as an efficient solution in the renewable energy sector.

"With the successful first synchronisation at Kathu Solar Park we are heading into the final stages of the construction and commissioning phase of the project, which will ultimately reach the commercial operation date (COD) for the plant in the next couple of months," says Siyabonga Mbanjwa, regional managing director, SENER Southern Africa.

Mbanjwa explains once fully operational, the Kathu plant, with its molten salt storage technology, will provide clean and reliable energy to 179 000 homes in the local community of the John Taole District Municipality, the Northern Cape and South Africa as a whole.

"At SENER, our aim is to provide the most innovative technology. It is such innovation that enables us to not only provide clean energy but to ensure that it is also reliable and sustainable," Mbanjwa adds.

Why concentrated solar power

CSP involves using large mirrors to reflect sunlight and collect solar heat to generate electricity. Kathu, being in the Northern Cape region, will benefit from this location as it has the highest level of solar radiation in Africa, as well as an abundance of available land, most of it flat, which makes the area ideal for the application of CSP technology.

By understanding that the problem of variability and intermittency of renewable energy sources can best be solved by storage, Kathu CSP has been fitted with SENERtrough®-2 collectors – a parabolic trough technology designed and patented by engineering and construction group, SENER.

The technology, built with a molten salt storage system, will serve both as a heat transfer and storage medium and allow 4.5 hours of thermal energy storage and improved efficiency of the plant.

According to Miguel Domingo, director of environmental and solar power business at SENER, the advantage of using this kind of storage technology for the grid is its ability to better match the amount of electricity with the storage. He says: "trough technology will extend the operational capacity of the plant allowing it to produce and steadily dispatch electricity in absence of solar radiation for a period of 4.5 hours, long after the sun has set and during cloudy or bad weather. This guarantees dispatchable energy generation to meet on-demand needs, especially during the evening peak."

Domingo explains that the SENERtrough-2 technology that will be used for the Kathu project has an opening that is nearly 30% larger than the previous versions, reducing the number of collectors required to generate the same amount of energy.

"A reduction in the total number of collectors aims to improve, by 30%, the optical area of the system and gives rise to a global reduction in the total cost of solar fields.

"This is an optimised collector model based on the know-how achieved by SENER in over 20 thermo solar plants around the world. It is a good solution for renewables and very specific for thermo solar," he adds.

The 100 MW greenfield Kathu solar power plant, situated in the Northern Cape Province has reached first synchronisation to the South African grid.

Future outlook for CSP

Francisco García Bueno, project director, ACCIONA Industrial, assures that the fear of job losses caused by renewable energy is unfounded; that in fact the anticipated energy transition is going to create a lot more jobs

"The participation of local companies in the construction of Kathu, as well as Spanish companies, has been key to reaching this synchronisation milestone.

"The principle that governs the entire project is that of sustainability in all areas: economic, social and environmental. That is why all activities are planned with the rigour and detail that both Kathu Solar Park and the John Taole District Municipality community demand of us.

"For the EPC consortium, plant synchronisation is one of the most important final milestones that will enable us to complete a process that began in 2016, and we achieved it with success and the greatest guarantees."

During the synchronisation phase, around 1 200 jobs are being created impacting positively the local employment prospects. In addition to this, it is estimated that the Kathu Solar Park will save six million tons of CO_2 over 20 years, and it will foster more local economic development through several project. ❑

Parabolic mirrors concentrating sunlight using trough-shaped reflectors onto a receiver pipe in order to produce electricity.

CSP technologies and advantages

Unlike photovoltaic (PV) systems, which harness solar energy by converting sunlight directly to electricity, CSP plants use the sun's energy to heat a liquid – often water or thermal oil – to high temperatures. The resulting heat energy is then used to power a traditional steam turbine-generator set to create electricity.

Compared to PV systems, CSP is best for distributing energy during off-peak hours or seasons through longer-term storage of systems, as opposed to requiring battery storage systems or being limited to producing energy during sunlight hours.

Linear solar concentration

Parabolic trough systems collect and concentrate sunlight using parabolically curved, trough-shaped reflectors, onto a receiver pipe, which contains heat transfer fluid and runs along the focal line of the parabolically shaped trough.

Heat is produced from the fluid, usually thermal oil, at around 400 °C and is transferred to water in a heat exchanger that produces steam, which is then used to power a turbine generator to produce electricity.

Fresnel trough technology is similar to the parabolic trough. It consists of a series of long flat or slightly curved ground-mounted reflectors that track the sun in one axis and focus the beam radiation onto fluid carrying receiver tubes, which are elevated above the mirrors.

The mirrors are laid flat on the ground and reflect the sunlight to the pipe above, similar to parabolic trough systems.

The Fresnel technology differs from parabolic trough in that the absorber is fixed in space above the slightly curved or flat Fresnel reflectors. Sometimes a small parabolic mirror is added to the top of the receiver to further focus sunlight.

Point focusing CSP systems

Solar tower or power tower systems use sun-tracking mirrors called heliostats to concentrate sunlight onto a boiler at the top of a tower.

Thermal energy is transferred to the heat transfer fluid, which is pumped up the tower and through the receiver, where it is heated to temperatures of up to 550 °C. The heated liquid is used to produce steam from water, which uses a conventional turbine-generator to produce electricity. ❑