



# SENER has giant heliostats for its Gemasolar thermal plant produced using Nikon Metrology Laser Radar

Laser Radar helps Moncobra assembly team secure the geometric integrity of 2,650 Gemasolar heliostats

Construction works are currently ongoing to complete Gemasolar, the world's first commercial plant with central tower and heliostat array technology to include a thermal storage system. The high-precision heliostats precisely reflect the sun beams toward the sunlight receiver located at the top of a 300 meter high tower. SENER's heliostat assembly subcontractor Moncobra uses Laser Radar to precisely position flat mirror panels arrays on giant heliostats. Laser Radar completes automatic non-contact and gauge-free inspection of a single heliostat in a matter of minutes, allowing Moncobra to turn out 22 heliostats every day using a single Laser Radar. This is one of the many technology innovations SENER introduced to maximize the output of its concentrated solar power (CSP) plant portfolio, supplying electricity in line with demand.

## **Innovation drives the thermosolar power industry**

Gemasolar is a milestone project from Torresol Energy, a joint venture between SENER and financial partner Masdar. SENER – an large engineering, construction and systems integration

company – started up Torresol Energy to build the world's first CSP plant featuring tower technology with a molten salts receiver. This thermal storage concept allows Gemasolar to continue producing electricity also when a cloud passes over. Although the use of a tower surrounded by flat-mirror heliostats is less matured than parabolic trough technology, it potentially offers a higher energy yield. Starting in 2011, Gemasolar will supply clean and safe energy to 25,000 homes and reduce CO2 emissions by more than 30,000 tons a year. The official Gemasolar video can be consulted by clicking the "Gemasolar plant video (2010)" link on the <http://www.torresolenergy.com/TORRESOL/gemasolar-plant/en> webpage.

"The 2,650 heliostats surrounding the tower are moved around two rotation axes to reflect sunlight towards the receiver in the tower," says David Fernandez, from SENER Structures and Mechanisms Section in Bilbao, Spain. "The Laser Radar instrument from Nikon Metrology has been selected to ensure accurate panel positioning during heliostat manufacturing. This ensures that reflected sun beams precisely point to the sunlight receiver in the tower up to 1 kilometer away. Accurate heliostat mirror positioning allows Gemasolar to capture as much heat as possible and distribute it evenly across the outer receiver surface to avoid damage due to overheating."

Abrox, Nikon Metrology's reseller for large-scale metrology in the Iberian region, introduced Laser Radar as a suitable system for measuring heliostat mirror surfaces.

With thousands of 11 x 12 meter heliostats targeting the sunlight receiver, the salt substances heat up and descend to the hot salts tank where they are stored at more than 500 degrees Celsius. From here, the salts are transferred to heat exchangers and subsequently to the turbine and electrical transformer, before adding electricity to the net grid.

### **Automated mirror panel inspection using Laser Radar**

The first step in building a Gemasolar heliostat is combining 7 individual mirror panels to form a single row of mirrors. All mirrors are sprayed at fixed areas to facilitate automatic laser inspection after finishing heliostat construction. Moncobra assembly workers mount 5 of these mirror rows on the heliostat's structural core. To measure heliostat mirror surfaces from above, the Laser Radar instrument has been tilted and mounted on a post. A rotary table has been integrated to easily switch measurement between four transportable heliostat assembly decks.

"The Laser Radar is a productivity multiplier," says Francisco Balaz Jimémez, Project & Production Manager who manages the on-site Moncobra heliostat manufacturing team. "Measuring heliostats with a Laser Radar is faster and more practical than any other measuring system that I know. It saves us a lot of time because we are able to measure mirror points without having to manually touch the points ourselves. We run measurement routines that have been programmed off-line so that we can use the Laser Radar to automatically inspect one heliostat after the other."

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*The Laser Radar is a productivity multiplier.*

*Francisco Balaz Jimémez, Project & Production Manager*

When an operator starts the inspection routine, the Laser Radar system measures the 4 locations on the reflection side of each of the 35 mirror panels, precisely facing the attachment points. Francisco Balaz Jimémez remarks that all produced heliostats are inspected in Enhanced Metrology mode. "For every point of a heliostat's 140 point locations, the Laser Radar scans a 5 by 5 millimeter region to search the precise position to take the measurement. 4 tooling ball units placed on the supporting heliostat structure serve as the reference plane for the automated inspection sequence."

### **The only metrology system fit for the job**

All heliostats are designed to exhibit a different slightly parabolic reflective shape, depending on the position of the heliostat in relation to the tower. Immediately after



*Laser Radar helps achieve the slightly parabolic reflective shape that is different for each heliostat.*



*Gemasolar is the world's first CSP plant featuring tower technology with a molten salts receiver.*



*To measure heliostat mirror surfaces from above, the Laser Radar has been tilted and mounted on a post.*



*Building a Gemasolar heliostat starts by combining 7 individual mirror panels to form a single row of mirrors.*



*To complete a heliostat's reflective surface, assembly workers mount 5 mirror rows on a structural core.*

completing inspection, the measurement report rolls out of the printer and is automatically saved on the network and sent to SENER. David Fernandez explains that the Laser Radar measurement data decide whether the required curvature for each heliostat mirror array is achieved within specification. "Based on the mirror deviation values specified in the inspection report, assembly workers simply add bolt washers of different thicknesses at the mirror attachment points. After tuning the mirrors, the Laser Radar runs final inspection verification to confirm accuracy under 1 millimeter before turning out a new heliostat."

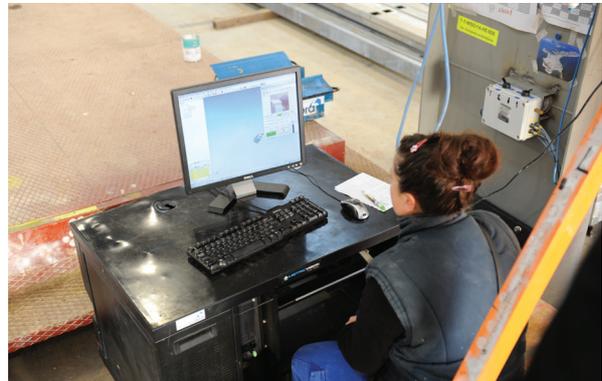
Altogether it takes roughly 5 minutes to take a single heliostat's 140 measurement points in Enhanced Metrology mode. This is much shorter compared to a laser tracker system that was considered for purchase before the Laser Radar system was selected. And also much less cumbersome because the laser tracker requires a crane to precisely position a large gauge with spring-loaded targets on top of a heliostat's reflective surface. "With the Laser Radar, we are able to avoid the complexity of taking measurements using laser trackers," concludes David Fernandez. "Non-contact inspection performed in a fraction of the time has been the main driver for us to opt for the Laser Radar inspection system. Despite harsh circumstances characterized by dry soil dust and extremely high temperatures, we believe it is the only metrology system available that is fit for the job. The Laser Radar is a key component in realizing our objective to generate electricity with greater efficiency and higher thermal storage capacity than parabolic trough technology. Gemasolar is an international reference and a starting point in the cost-cutting strategy of the thermosolar power industry, paving the way for similar plants around the world."

A rotary table has been integrated to easily switch measurement between four transportable heliostat assembly decks.

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*Measurement routines have been programmed off-line to free up the Laser Radar for serial heliostat inspection.*



*Bolt washers allow assembly workers to apply the correct spacing to each mirror attachment point.*