HELIOTROUGH®

One Year Experience with the Loop in a Commercial Solar Power Plant

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1. Introduction

In 2005, Flagsol GmbH jointly with Schlaich Bergermann und Partner (sbp), Fraunhofer Institute for Material Flow and Logistics (IML), and German Aerospace Center (DLR) started the development and design of the next parabolic trough collector generation to replace the current industry standard technology, particularly the SKALET collector. Within the ANDA NT project co-funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of Germany the HelioTrough® Design was created – significantly larger than the current design standard, highly efficient and low-cost assembled by providing economies of scale. The subsequent project ANDA- NTpro was launched to realize two collector elements for testing it under commercial conditions. Finally, an 800 m test Loop has been erected as part of a commercial solar power plants and commissioned at the end of 2009. Since then the performance evaluation is in progress. This project is co-funded by the US Department of Energy. Although Flagsol will not receive the final results of the performance tests before the end of the year, it is already clear today that HelioTrough® has met the expectations after the last six months of detailed measurements. In serial production it should be the most efficient parabolic trough collector on the market and be realized in some large utility-size solar plants proposed for California and Nevada.

2. Description of HelioTrough Collector Structure

Four (4) Solar Collector Assemblies (SCAs) make up one HelioTrough® Solar Collector Loop. Each SCA is made up of ten (10) Solar Collector Elements (SCE) for a total length of approximately 190 m. Figure 1 shows the general arrangement of a HelioTrough® SCE.

Each SCE is approximately 19 m long. Forty-eight (48) curved Reflector Panels are attached to the SCE steel structure in 4 rows, forming the parabolic collector with 6.77 m width (aperture). The HCE is fixed to the steel structure by means of steel supports, one at every 4.8 m; each HCE is welded to adjacent HCEs to form continuous receiver piping in the SCA. Each SCE is supported at its ends by pylons.

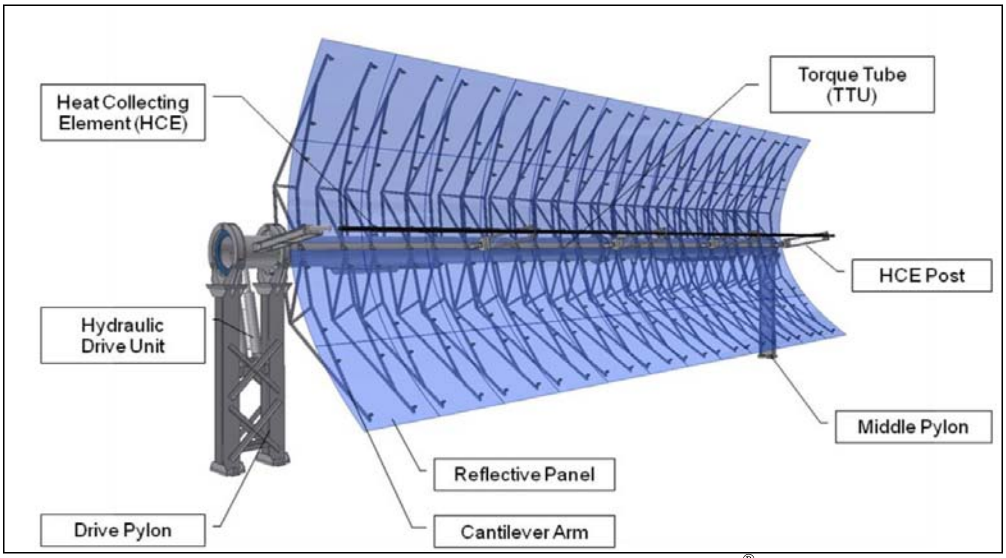

Figure 1: General arrangement of one HelioTrough® SCE

The ten individual SCEs composing each SCA are connected by bolted joints and bearing flanges to function as a continuous beam and to permit joint movement about the collector's longitudinal axis. Tracking is provided by the hydraulic drive system located at the center pylon in the middle of the 10 SCEs.

3. The HelioTrough Technology Innovations

The main innovations contain a bigger size in comparison with other troughs, a more precise geometry and an automatic assembly line. In detail the following steps has been realized:

- increased parabolic shape (in comparison to LS3, Aperture Width: 6,8 m)
- increased Solar Collector Element length (19 m)
- increased Heat Collecting Element length (4,7 m)
- increased Loop aperture area (about 5050 m²)
- 3D-Tolerance adjustment
- Non-interrupted reflector surface (the Reflective Panels (RP) form a continuous surface on each side of the hydraulic drive)
- bigger solar fields feasible
- stiff HCE post connection
- easy to clean
- reduction of parts
- simple stiff torque transfer
- development of automatic assembly line

These innovations cause both higher efficiency and lower costs and the feasibility to built bigger plants.

4 Torsion measurements

Torsion measurements were conducted on the HelioTrough® with several digital levels mounted to the collector. The collector was rotated in 1° increments and the torsion was measured.

The measurements were taken over a 100 m length for the HelioTrough®. Wind speed was below 4 m/s had a negligible effect on measurement. Due to the continuous torque tube on the HelioTrough® collector the torsion distribution is constant. Figure 2 illustrates the torsion measurements

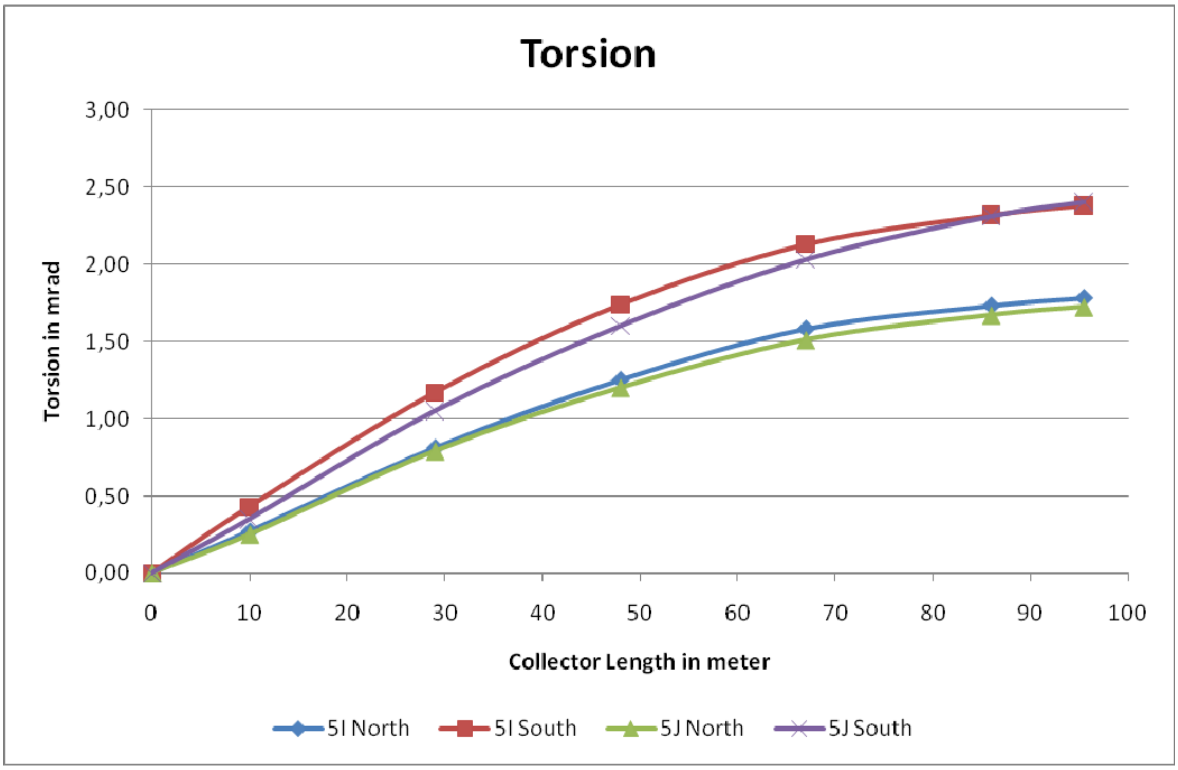

Figure 2: Torsion measurements.

5. Deflectometry measurement

The deflectometry measurement let expect an overall intercept factor higher than 98% (see figure 3).

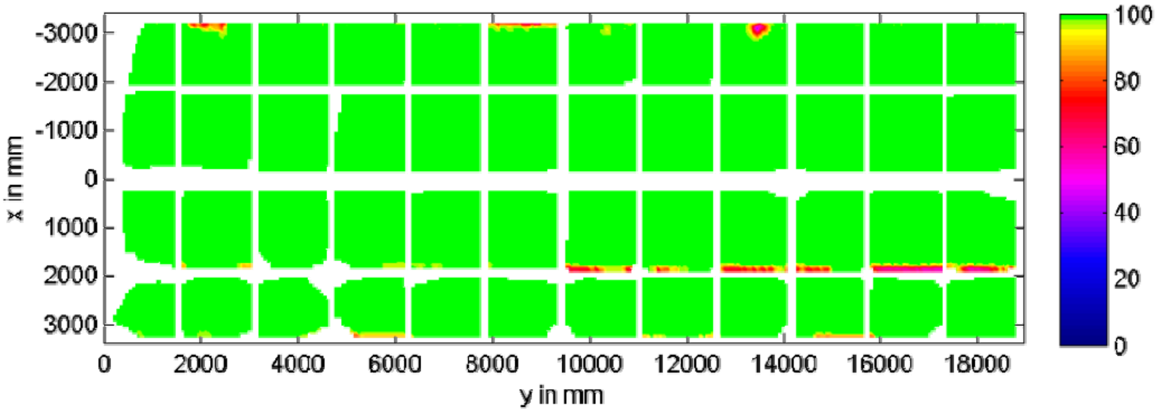

Figure 3: Intercept factor of one SCE as built measured with deflectometry by CSP Services GmbH.

6. Performance Results

Efficiency and thermal output of the loop are important information for properly sizing a solar field. It is necessary that the collector model accurately predicts the thermal output.

Figures 4 shows an example of predicted and measured efficiency and thermal output of the complete HelioTrough® loop.

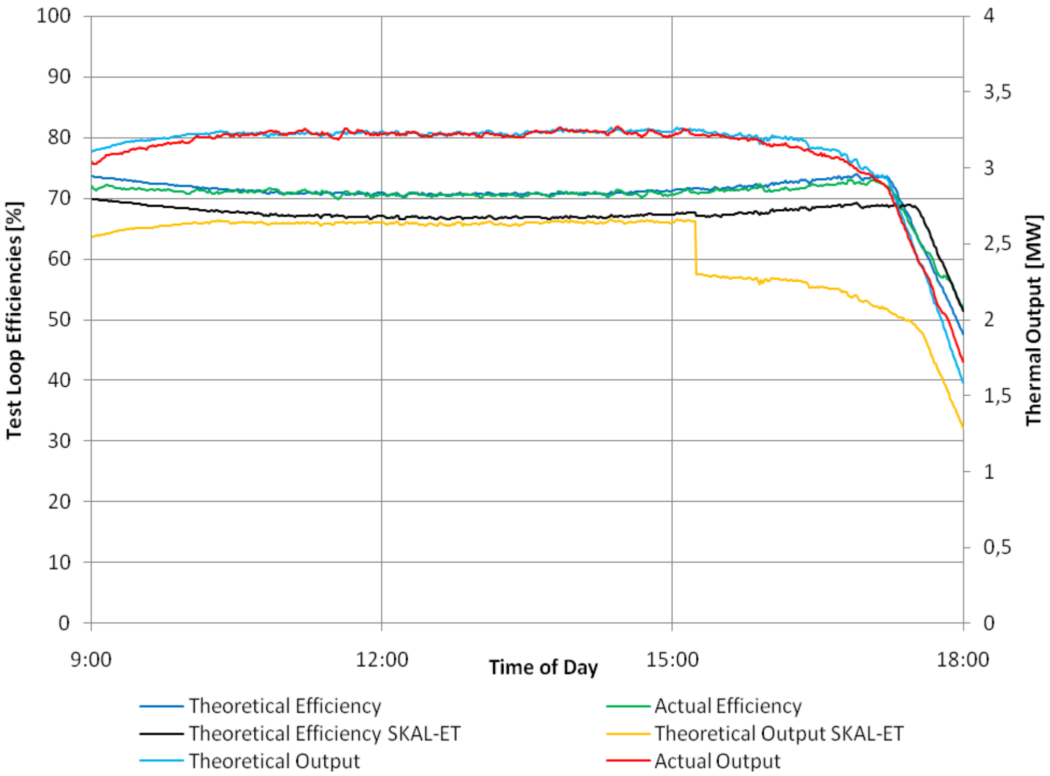

Figure 4: Efficiency and thermal output measured the 16th of April, 2010.

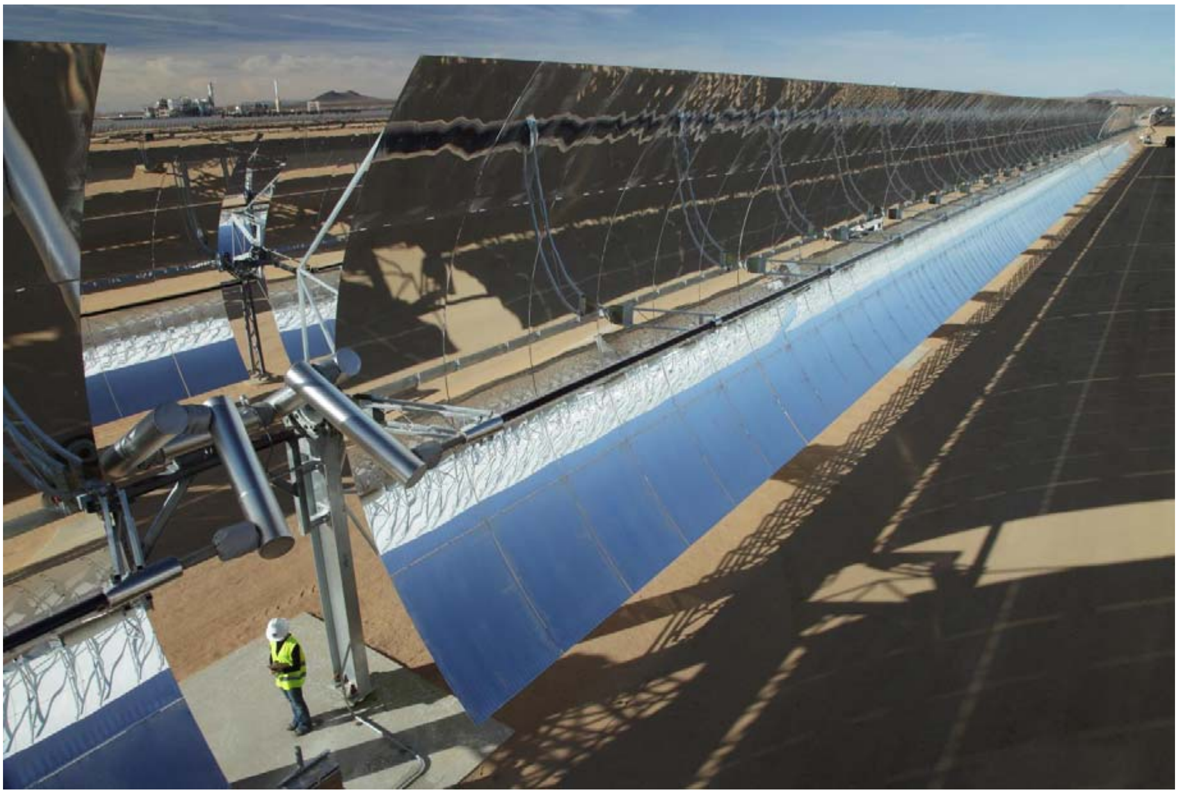

Figure 5: HelioTrough® Demo Loop