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Institute of Solar Research

QUARZ®

Test and Qualification Center for CSP-Technologies

DLR

Linear solar simulator for receiver tests in the QUARZ laboratory in Cologne

Mirror shape measurement in the QUARZ laboratory in Cologne

Result of collector shape measurement in the field

About the Institute of Solar Research

The DLR Institute of Solar Research is the largest research entity in Germany investigating and developing concentrating solar technologies to provide heat, electricity and fuels. Its 140 employees work at DLR sites in Cologne, Jülich and Stuttgart, as well as at the largest European test centre for concentrating solar technologies, CIEMAT's Plataforma Solar de Almería (PSA) in southern Spain.

In Germany, the institute is the pioneering research organization for advancing concentrated solar power (CSP) technology. Both in Europe and on a global scale it acts as a prime mover for the development and qualification of solar power and allied technologies.

The Institute of Solar Research and its commercial spin-off, CSP Services GmbH, each pursue their own separate but complementary range of activities. CSP Services GmbH holds a DLR know-how licence and has developed its own portfolio of products and services.

QUARZ® Test and Qualification Center for CSP-Technologies

The QUARZ Center handles all CSP testing and qualification research activities and services of the Institute of Solar Research. Our staff work at the DLR sites Cologne and Jülich as well as at the PSA.

CSP components, their interaction in the overall system and the meteorological conditions each have a strong impact on the performance and cost efficiency of a solar power plant. Our researchers develop suitable measurement techniques and devices for testing and qualifying these influential factors. From our results, we evolve guidelines and standards for testing methods and quality criteria.

We transfer our research results to customer oriented services. Our testing and qualification services deliver fundamental information for industry to improve quality, performance and competiveness of their products and processes.

Additionally, we provide consulting services and support during all component development phases, from R&D to integration in a CSP plant.

Extensive training courses on CSP systems complete our range of services.

Components

We test CSP components using specifically developed methods and devices, working in laboratories and outdoor test facilities. CSP companies and plant operators worldwide highly value our test reports as documentation of product quality.

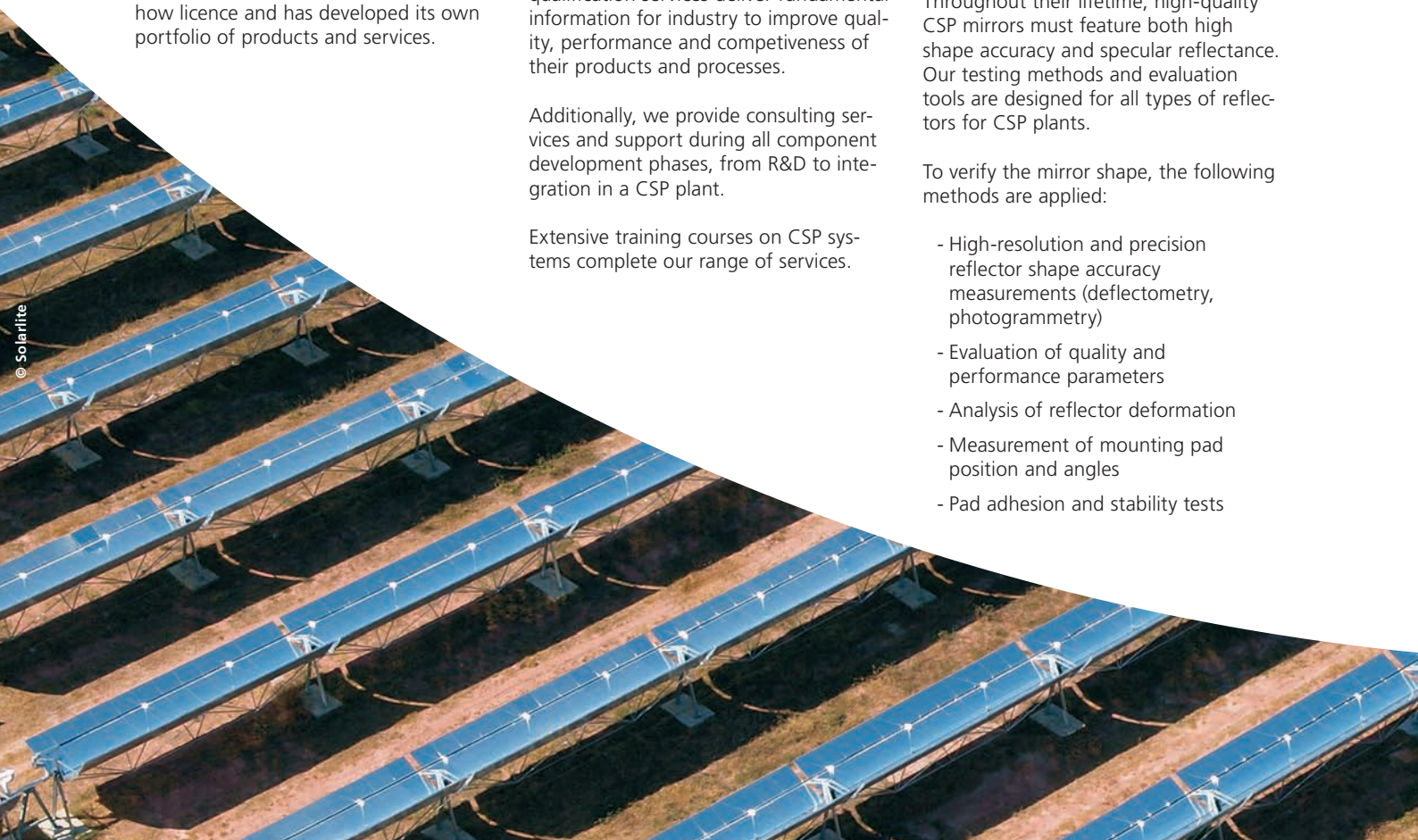
Parabolic trough receivers
During the early product development stage we test the physical properties of material samples, such as coatings of glass envelopes or absorber tubes.

For prototypes and commercial receivers, we test the overall performance of the complete product. The performance of entire receivers is evaluated by measuring heat loss and optical efficiency. Furthermore, we verify their durability by means of overheating, thermal cycling and bellow fatigue tests. The test infrastructure at the PSA allows us to confirm the operability and efficiency of receivers under real conditions.

Mirrors
Throughout their lifetime, high-quality CSP mirrors must feature both high shape accuracy and specular reflectance. Our testing methods and evaluation tools are designed for all types of reflectors for CSP plants.

To verify the mirror shape, the following methods are applied:

- High-resolution and precision reflector shape accuracy measurements (deflectometry, photogrammetry)
- Evaluation of quality and performance parameters
- Analysis of reflector deformation
- Measurement of mounting pad position and angles
- Pad adhesion and stability tests



Rotating platform for performance testing of components at PSA

QFly – airborne collector shape measurement

Calibration of irradiance sensors at PSA

We evaluate the reflective performance of CSP mirrors by measuring their spectral hemispherical and specular reflectance. In close collaboration with CIEMAT we offer accelerated ageing tests following international standards to measure the effects of humidity, salt spray, combined UV and humidity, temperature cycling, irradiation and aggressive corrosion environments.

Outdoor ageing tests are conducted at Spanish and North African exposure sites to verify the results of the accelerated ageing tests. Any observed degradation effects are analysed microscopically to understand the underlying mechanisms. The reflective properties of samples are measured to detect possible performance losses.

Collectors
The performance of a collector is defined by the quality of its components as well as by their alignment and behaviour under different load conditions. Our testing methods are designed to measure and assess the following quality features of parabolic trough collectors and heliostats:

- Shape
- Deformation and torsion
- Tracking quality
- Parabolic trough peak efficiency, incident angle modifier and thermal losses
- Optimised heliostat canting by deflectometry
- Heliostat beam quality

Other components
We also offer the examination of heat transfer fluids with regard to their physical properties at high temperatures and their degradation behaviour. For collector drives we verify the correct implementation of sun position algorithms and analyse tracking characteristics under load. A testing facility for Rotating and Expansion Performing Assemblies (REPA) is in preparation.

Plants

The Institute of Solar Research has developed methods for assessing the solar plant performance of parabolic trough, linear Fresnel and tower plants. The assessment can be made for the optical or thermal plant portion, or for the complete system.

Parabolic trough and linear Fresnel fields
To measure the optical efficiency of parabolic trough and linear Fresnel fields we either apply our measuring technology from the ground or using camera equipped quadcopters (QFly).

Our mobile field laboratory enables us to verify the overall performance of larger parabolic trough units. The analysis of performance and operating data helps to optimise the collector and solar field output. Moreover, we examine single effects such as soiling or individual component defects.

Solar towers
For solar tower plants, we measure the optical quality of the heliostats in the solar field. We also offer flux mapping and aimpoint optimisation, and measure the thermal efficiency of the central receiver.

For all CSP technologies, we provide an estimate on the yearly solar production based on detailed measurement data.

Solar Resource Assessment

We deliver crucial knowledge on relevant solar resource parameters to project developers and solar plant operators.

We calibrate meteorological sensors, measure the DNI (Direct Normal Irradiance), the sunshape, component soiling and extinction between heliostats and receiver.

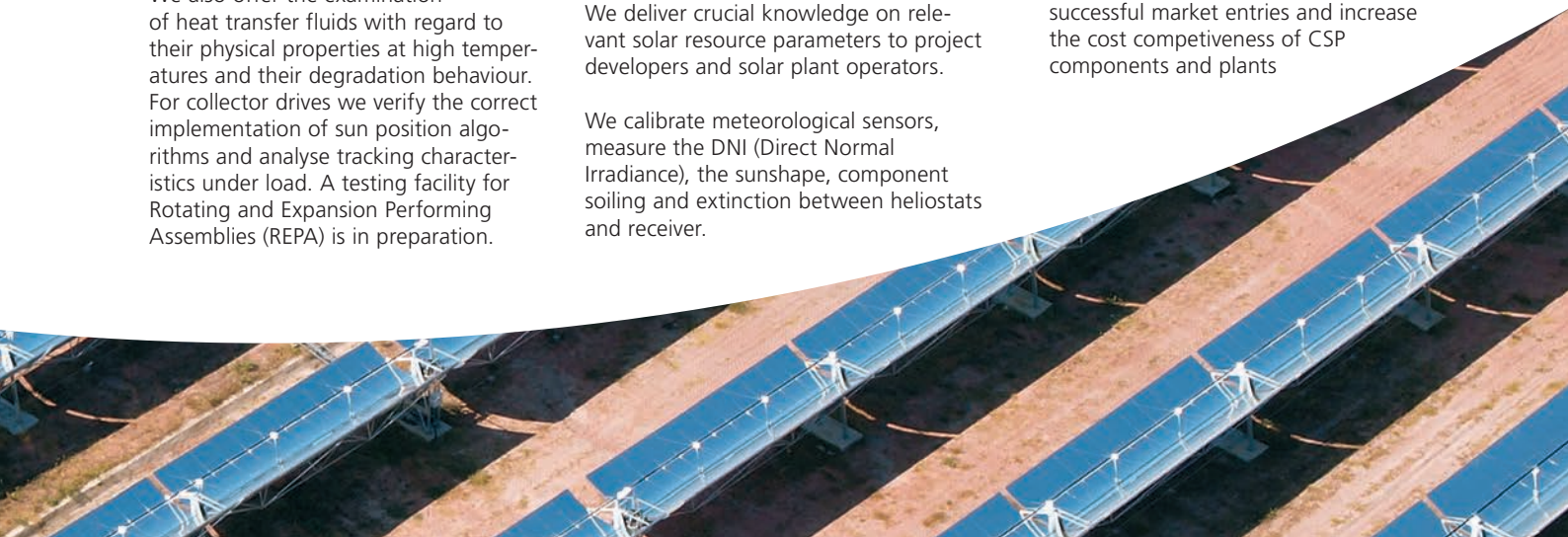
A new service we recently added to our portfolio is Nowcasting, the prediction of DNI for the next 30 minutes. Our measurements serve as a basis to consider the effects of the solar resource on plant design, operation and system performance.

The work is carried out either at the Meteorological Station for Solar Technologies (METAS) at the PSA or directly at the customer's site.

In addition we operate several meteorological stations in the MENA region. These stations provide valuable data on typical desert environments for commercial CSP plants in the region.

Benefits for our customers

- By detecting optimisation potential we help manufacturers to improve their products
- Customers benefit from the QUARZ test reports as proof of product quality
- Knowledge and use of accurate performance parameters lead to reliable results of system simulations
- Our test results are an excellent source of data for a plant's cost-benefit analysis
- Being aware of quality and durability is a precondition for risk mitigation and enhances the bankability of a project
- QUARZ Center services promote successful market entries and increase the cost competiveness of CSP components and plants



DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

DLR's mission comprises the exploration of Earth and the Solar System and research for protecting the environment. This includes the development of environment-friendly technologies for energy supply and future mobility, as well as for communications and security. DLR's research portfolio ranges from fundamental research to the development of products for tomorrow. In this way, DLR contributes the scientific and technical expertise that it has acquired to the enhancement of Germany as a location for industry and technology. DLR operates major research facilities for its own projects and as a service for clients and partners. It also fosters the development of the next generation of researchers, provides expert advisory services to government and is a driving force in the regions where its facilities are located.

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