CEA
Clean Energy Associates

Investment Confidence

ENGINEERING ONSITE SERVICES OVERVIEW

Onsite Testing Services

Clean Energy Associates is the leading provider of onsite testing services to the global solar industry. With more than 13 GW of engineering services experience under its belt, CEA helps project developers, IPPs, EPCs, financial institutions and other downstream partners maximize their ROI by ensuring their modules are manufactured to the highest standard.

North American owned and operated, CEA's experienced engineers are trusted advisors to clients all over the world reducing technical and financial risk by providing unbiased, unrivalled advisory and technical due diligence services.

1,000+
Years of industry experience

175+
Employees

130+
Engineers

13+
Years exemplary track record

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Why Is Onsite Testing So Important?

Benjamin Franklin said it best: "An ounce of prevention is worth a pound of cure."

Franklin was talking about fire safety but his advice is just as applicable to today's solar industry. While solar PV is a proven technology with huge potential upsides for investors, the manufacturing side of the industry is still relatively young meaning any number of issues can affect the quality of the modules during the manufacturing phase.

Even the largest Tier 1 suppliers are still perfecting their manufacturing processes making it a challenge for anyone without expert guidance to source top quality modules on a consistent basis. With a physical presence in 10 countries – including a strategic headquarters in Shanghai - CEA has its ear so close to the ground, it can tell clients if the quality standards have changed at the same factory from one year to the next.

CEA's onsite testing processes include:

Loose Module Testing

The Post Shipment Inspection (PSI) is a critical part of solar module quality control. Without this thorough inspection, it is not uncommon for modules with defects undetectable to the human eye, to make it through the installation process.

Installed Module Checks

To evaluate installation quality, CEA uses a variety of tests - including aerial IR testing by drone - to inspect every module at a plant. In 2018, CEA inspected over 180,000 modules in just three months at a project in Northern Europe.

Module Test Results Evaluation

Following the physical inspection of a solar plant or project, CEA's technical team evaluates the data to ensure no stone is left unturned when it comes to discovering even the smallest defect in a single module. CEA maintains one of the largest EL image libraries in the solar industry meaning we can leverage data science for optimization.

Damage Analysis and Reporting

The final step in CEA's onsite services is the in-depth analysis of any defects discovered during testing followed by the submission of a comprehensive report to the client. In addition to a list of findings, these reports include recommendations to rectify any issues that are causing the project to underperform.

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Types of Onsite Testing Performed By CEA

1. EL Testing

Electroluminescence (EL) is a phenomenon in which light emission occurs when current passes through a PV module. The emitted light is not in the visible spectrum, but in the infrared spectrum. This phenomenon can be imaged with a specialized camera and long exposure, which can help identify defects not visible to the naked eye. Spots that do not emit light will also fail to ingest sunlight. EL Imaging can be conducted day or night to detect defects such as microcracks, short-circuited cells and bus/finger contact irregularities. These tests are also used to detect Potential Induced Degradation (PID) and Light and Elevated Temperature Induced Degradation (LeTID).

2. IR Inspection

Infrared thermography is a non-destructive measurement technique used to detect and characterize defects and degradation in solar modules and BOS components. This technique measures infrared radiations using thermal detectors to obtain the surface temperature distribution profile. Temperature distribution at the surface indicates the internal structure and properties of the object. Any defect in an object will result in abnormal surface temperatures such as hotspots. Infrared thermography can help detect construction and installation errors, cold soldering issues, cell mismatch, and security and fire risks.

3. IV Curve Tracking

IV Curve Tracing is an electrical test that verifies photovoltaic array performance. The IV Curve represents all the possible operating points of a solar module – or string of modules – at existing conditions of sunlight and temperature. Knowing the electrical IV curve of a solar module is critical in determining the device´s output performance and solar efficiency. One bad module can affect the production of an entire string that is connected to the module. Low performance can also provoke problems such as hot spots. Tracing helps identify other issues such as bypass diode problems and PID.

4. BOS Testing

There are many electrical Balance of System (BOS) components in any solar project including conductors, conduits, combiner boxes, protection devices, disconnects, grounding conductors and monitoring devices. These components are designed to minimize electrical system losses and withstand operating conditions so making sure they are in working order is critical to power production. BOS testing services encompass a wide range of verifications such as inverter efficiency, voltage drop measurement, polarity verification tests, visual inspection, and grounding resistance measurements.

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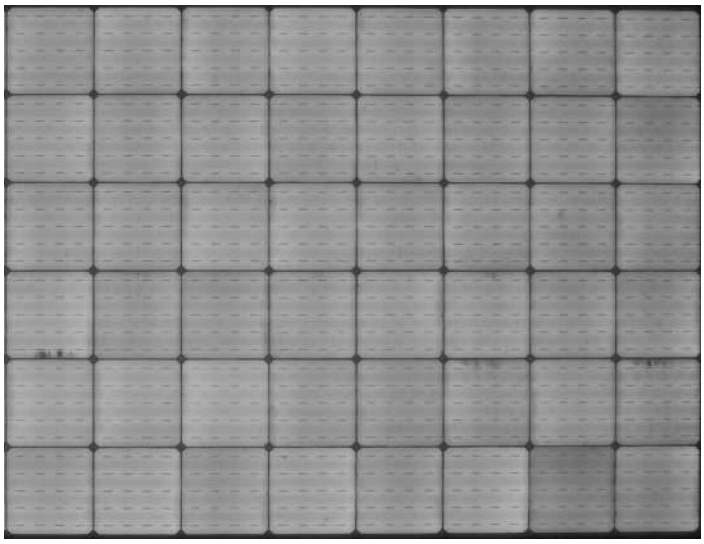
Reference Cases: Onsite Testing

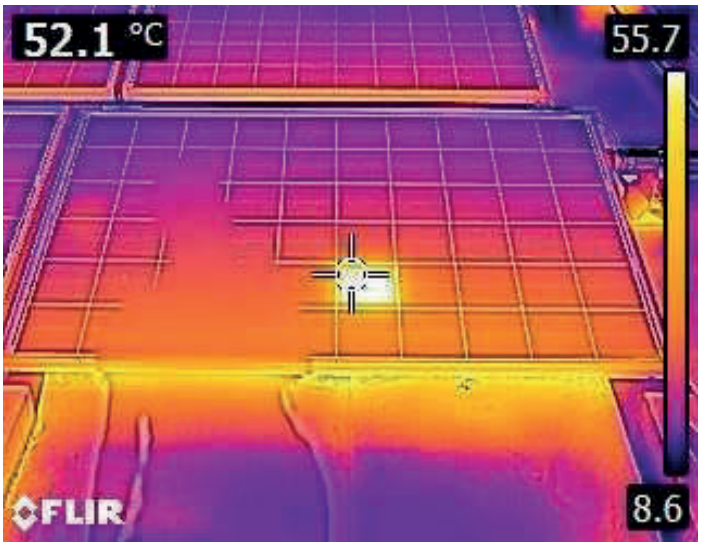


EL Testing

Project: 50 MW
Client: O&M Provider
Objective: Verified module defects
Findings: Microcracks, cold soldering issues

IV Curve Tracing

Project: 2 MW
Client: Project Developer
Objective: Commissioning verification
Findings: Commissioning verified and report was performed correctly



IR Inspection

Project: 100 MW
Client: Fortune 100 Company
Objective: PV system failure diagnosis
Findings: Faulty system component connections, hotspots

BOS Testing

Project: 100 MW
Client: Fortune 100 Company
Objective: PV system failure diagnosis
Findings: Wire abrasion

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