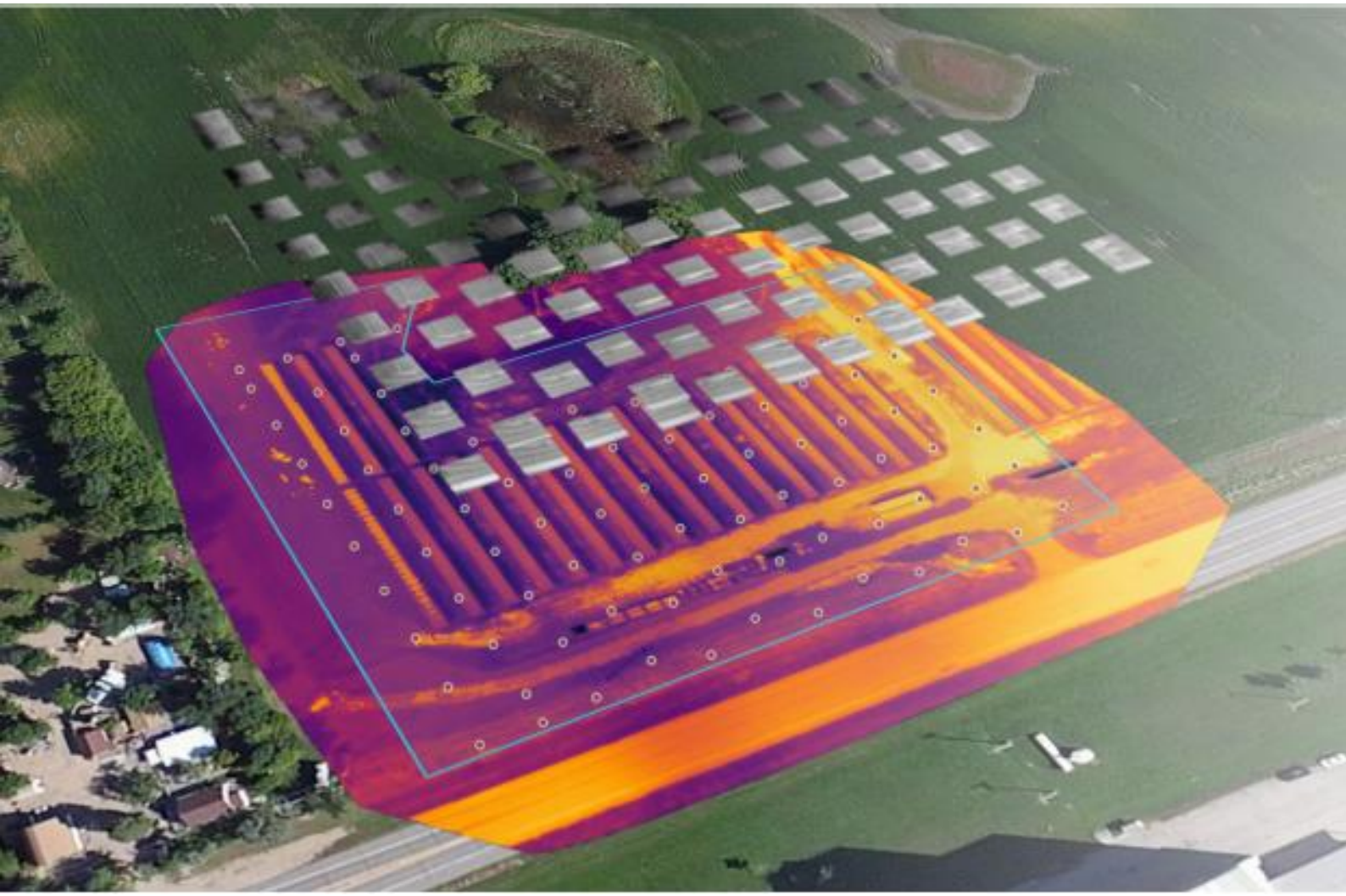
SPECTRE
UAV CONCEPTS



PV and Grid Distribution Infrared Inspection Services

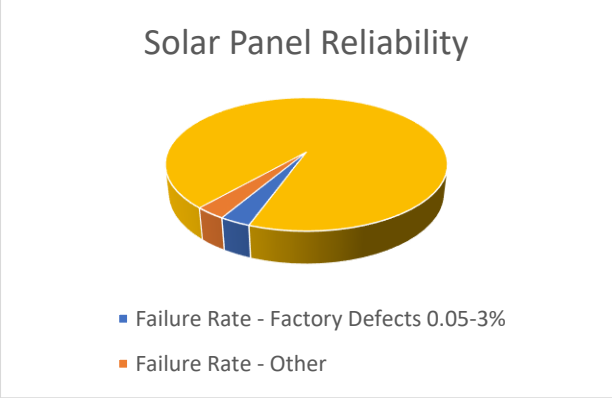
As industries continue to adopt new and innovative technology we are seeing dramatic improvements to operational capacities, increased efficiency and ever-safer work environments.

Spectre UAV Concepts has leveraged the evolution of un-manned aerial systems and the down-sizing of sensors to design and build an industry-grade infrared system that delivers unparalleled results.

Our detailed reports help businesses work faster and smarter, empowering teams to make informed decisions based on accurate, real time information. Minimise unscheduled downtime, improve efficiency and boost productivity with a **Total Solar Solution** from Spectre UAV Concepts.

Common Faults and Panel Degradation

A recent report from the National Renewable Energy Laboratory (NREL) at the U.S. Department of Energy examined 54,500 PV systems to determine the average failure rate of PV panels. They found the average failure rate to be 0.05%-3%. For a 10MW site, that equates to the failure of roughly 16 – 990 panels per year. These figures are reflective **ONLY** of panel failure due to factory defects and are not inclusive of damage caused by external factors.



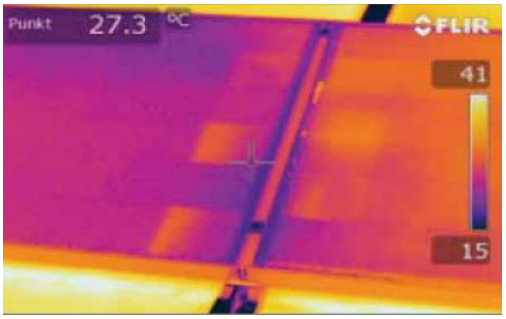
It is not uncommon for panels to be damaged during installation as a result of careless handling, improper mounting and overtightening of brackets.

Often, damage to panels is internal and invisible to the naked eye. These faults create hot spots that are detectable with an infrared radiometer. If left unchecked, excessive heating can lead to serious damage and impacting plant production.

Industry Case Study

Learn how a US solar farm recently saved $1,000,000 in replacement costs alone **Click Here**

Hot Spots



Hot spots are areas of elevated temperature affecting only part of the solar panel. They are a result of a localised decrease in efficiency, which results in lower power output and an acceleration of material degradation in the affected area.

Solar panels generate significant power and hot spots can occur when some of that power is dissipated in a localised area. Hot spots are rarely stable and will usually intensify until total failure of the panel performance in terms of electricity production and/or safety.

Causes for Hot Spots

There are multiple causes of hot spots, and they can be functional or operational. The **functional reasons** can be divided into two areas:

- Cell mismatch occurs when cells of varying current production are connected in series.
- Cell damage can occur during the production process because the silicon cell will be subjected to many stresses during lamination, handling and transportation.

Operational reasons for hot spots are related to solar farm design and operation, and can include:

Winter Shading

- An EPC company may want to accept shading conditions in winter to increase electricity production in summer. Panels will suffer systematic shading of the bottom row of cells every morning and evening during winter.

Rooftop / Site Conditions

- Rooftops can present challenges. When cells are completely shaded by structures or vegetation, this may be sufficient to trigger the bypass diode, resulting in increased temperature which will degrade the panel.

Soiling

- Panels can be soiled due to dust, dirt and other contaminants during their lifetime, reducing the efficiency and yield of the installation. Soiling can have dramatic consequences on the safe operation of the site as well as its operability.

The Solution

The solution is simple… regular inspections. When it comes to large arrays, traditional terrestrial inspection methods are costly and time consuming. Adopting a UAV inspection program will save your business both time and money. The commissioning stage along with end of manufacturer's warranty are two examples of when a Thermal Infrared Inspection are vitally important. Systems that took days or weeks to inspect can now be surveyed in hours with increased accuracy via our UAV platforms.

Why choose us?

Spectre UAV Concepts have developed a **Total Solar Solution**, helping O&M teams to increase efficiency and reduce their costs. We work closely with your team to create an effective Infrared Inspection program, providing you with the tools to implement targeted, predictive maintenance procedures. Routine inspections allow us to track changes in your site over time, detecting failure patterns that may lead to the diagnosis of higher-level issues. Early fault identification can help to eliminate unscheduled downtime, improve site safety and ensure optimal site performance year-round.

We are a team of **qualified thermographers and electricians** with over 25 years' experience in the engineering industry. We are trained and qualified to detect, interpret and report on a range of systems including high voltage electrical installations.

A true understanding of thermography is key to producing reliable results. Our thermographers are **certified by the Infaspection Institute**. Recognised globally as the leading independent certification for thermographers, we adhere to their strict inspection and reporting standards.

Using the latest in terrestrial and unmanned systems to provide rapid, cost effective solar inspection solution.

Our inspection and reporting services are designed to help you quickly identify issues and target your maintenance accordingly. We strip back the mountains of data that we gather to provide you with an effective and concise report, highlighting areas of concern and localising defects using GPS markers on a site plan. We will investigate any anomalies and provide high-resolution 42megapixel images of any observable damage. We inspect everything from PV panels to junction boxes and switch rooms.

Our custom built, high resolution aerial imaging platform is something of a rarity and allows us to provide exceptional detail and quality results to our clients. We use the latest professional grade cameras and an assortment of cinema lenses with complete dual in-flight control.

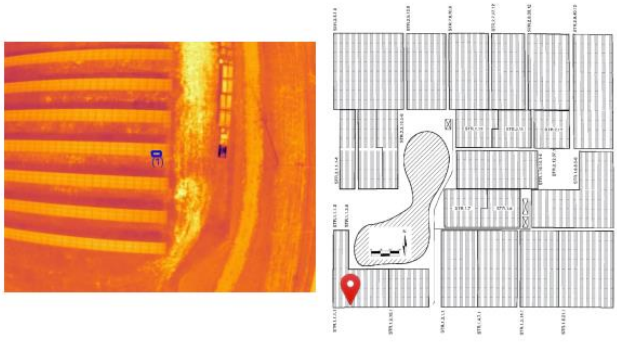
Thermal Infrared radiometers measure the radiant energy emitted by an object and translate that value into a temperature reading. As they do not measure temperature directly, they are subject to misinterpretation and false readings. A certified thermographer will understand the variables involved and have the knowledge to compensate accordingly, providing an accurate, valuable result.

Our inspections can help to identify:

- **Module faults:** These include individual hot spots on the cells, diode failures, shattered or dirty modules, coating and fogging issues, and junction box heating.
- **String and system faults:** Wiring issues (reversed polarity, frayed cables), charge controller issues, and inverter and fuse failures.
- **Racking and balance of system:** These are major issues with how the modules are mounted.

Our detailed reporting provides:

- **High-level summary.** A summary of defect types and number of defects allowing your O&M team to prioritize which areas need immediate attention.
- **Localization.** Your crews need to know exactly which string or module they need to fix. Our report will save them time and allow them to do their job faster and more efficiently.
- **Data reduction.** Our report will be reduced to the images that highlight specific faults. Most inspections will produce well over 1,000 images. We only send you the important ones.



DJI_0066.jpg
multiple_cell
demo: panel (1)
Average: 94.66 °F
Min: 89.59 °F
Max: 105.66 °F
demo: Module appears shattered.

Lat, Lng: XX.XX94651, -XX.XX16204
Time: 2017-08-08T21:31:42+00:00

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Why not enquire about our services today? We offer competitive pricing and unparalleled results. Trust a certified thermographer to provide the accurate, detailed information that you need, just keep an eye out for the Infraspection logo.