

The PV testing facilities at CSIR



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Overview of the PV test facilities at CSIR

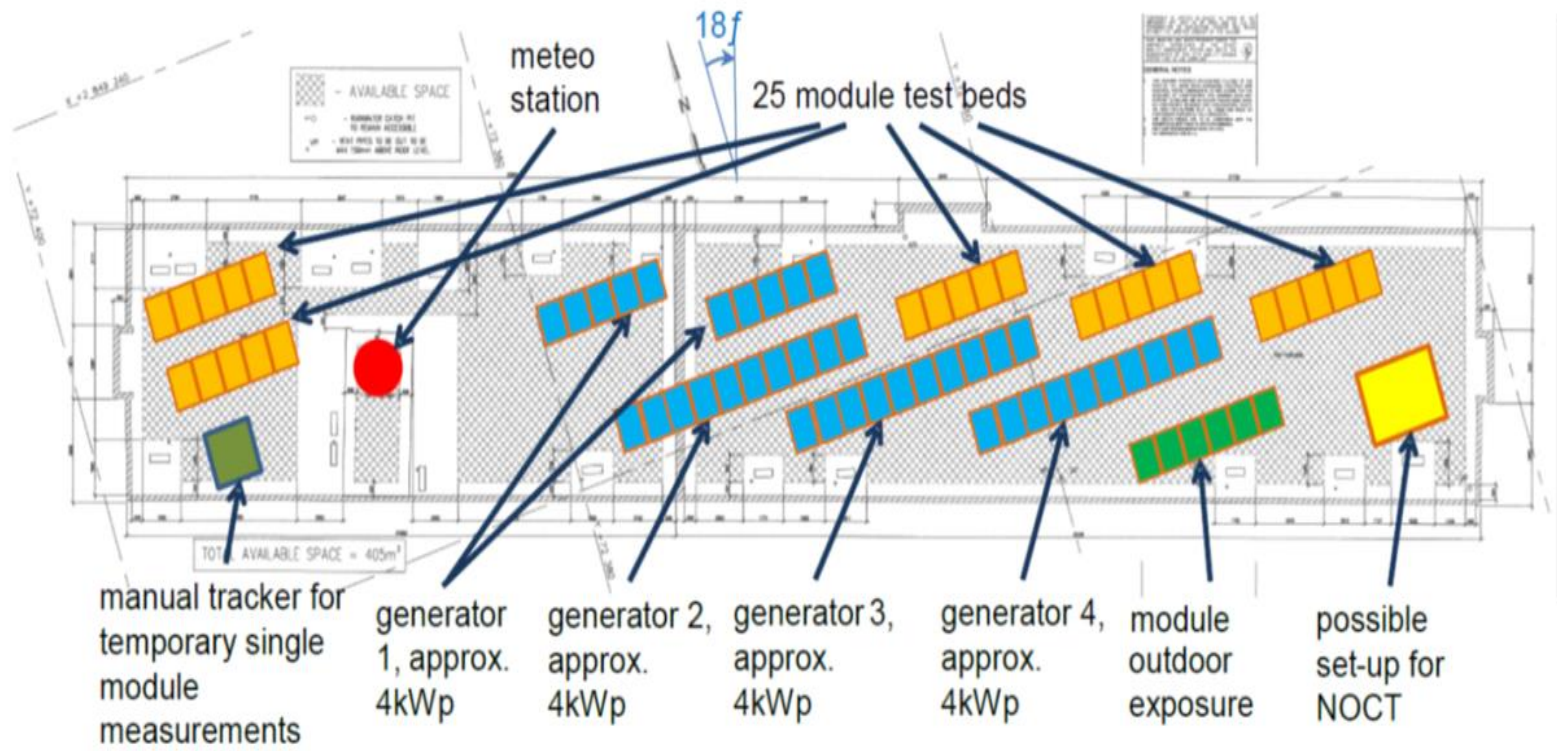
Outdoor test facilities

- PV module I-V characterization
- NMOT
- Outdoor exposure
- Sun tracker system
- Grid tied PV systems
- Measuring system
- Meteorological measurement system

Indoor test facilities

- Pulsed solar simulator

Overview of the PV test facilities at CSIR



PV module I-V characterization

⇒ Energy yield monitoring is needed to study the performance of PV modules under the specific conditions of a certain location.

- 15 measurement slots (expandable up to 25 slots)
- Temperature monitoring of every single PV module
- MPP tracking and I-V measuring by electronic loads
- Simultaneous measuring of PV modules and weather data



PV module I-V characterization

1 PV rack is configured to measure albedo effects.

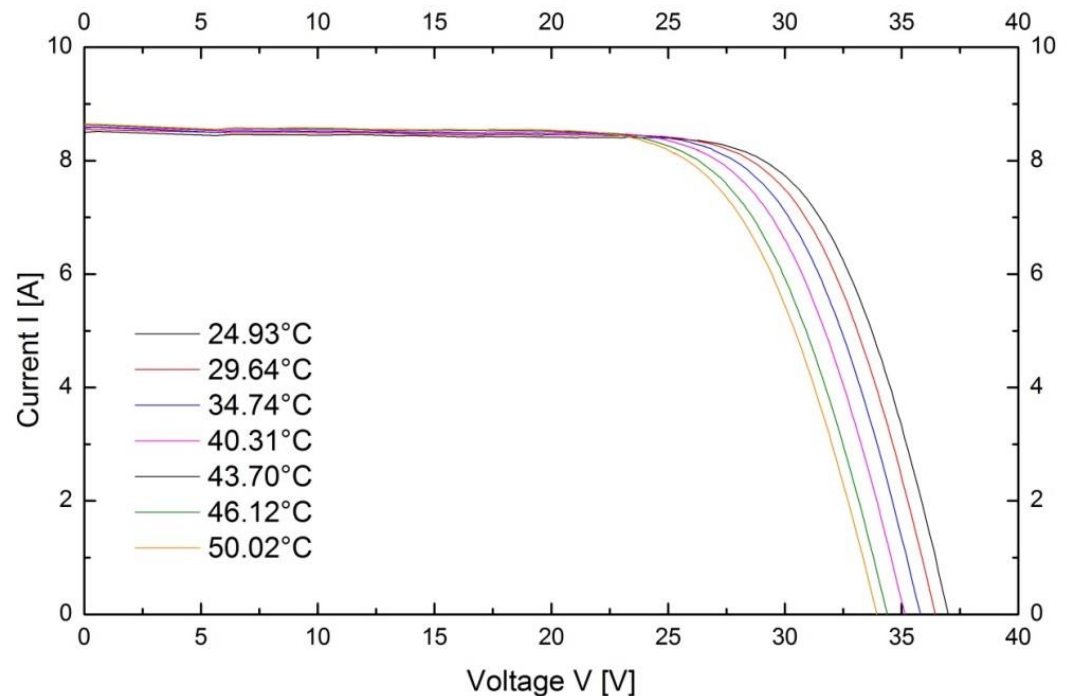
- Bifacial PV module measurement
- Research on various floor conditions



NMOT

⇒ The NMOT test is performed to determine the influence of the cell temperature to the power of a PV module.

- Module temperature affects the power output
- Ambient temperature, solar irradiance, wind speed, installation structure and electrical load affect the cell temperature



NMOT

- PV modules operated at MPP
- Measurement of:
 - Wind speed in module plane
 - Solar irradiance in module plane
 - Ambient temperature
- 4 PT100 temperature sensors attached to modules backside
- PV module framing plates



Outdoor exposure

⇒ The outdoor exposure test detects PV module degradations before performance test in the laboratory and enables research in long term degradation determination.

- Degradation and stabilization of PV modules before performance tests
- PV module aging
- Module will be operated at MPP
- Irradiance measurement in module plane
- Degradation period of 60 kWhm²



Sun tracker system

⇒ PV module power determination under natural sunlight and various angles.

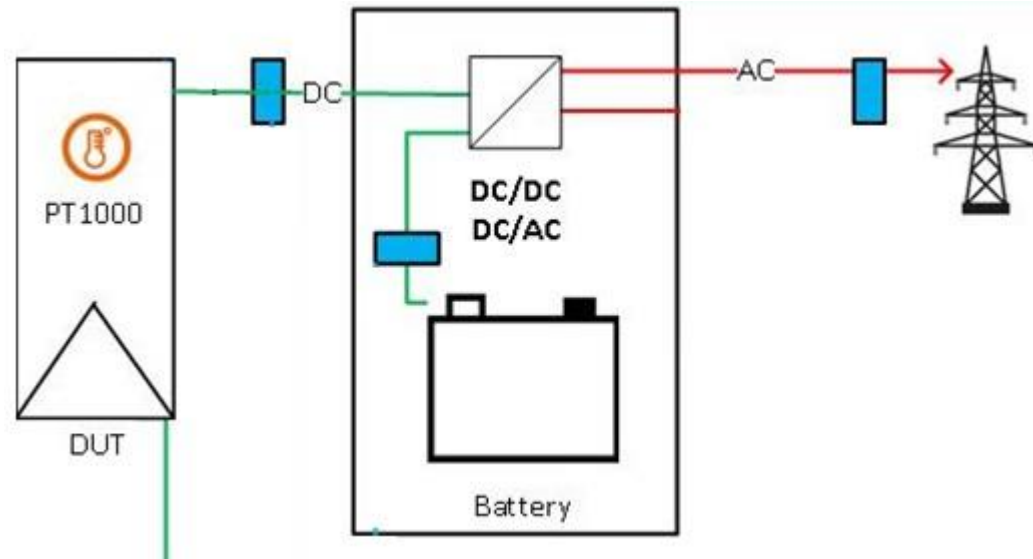
- Performance measurements at various angles
- Outdoor calibration of irradiance sensors
- Reference cell in module plane
- Simultaneous IV measurement of 2 PV modules by electronic loads
- Temperature measurement of modules and reference cell



Grid tied PV systems

⇒ Performance and efficiency determination of PV generator systems.

- 2 grid tied PV systems
 - standard grid tied system
 - battery storage integrated system
- DC power input of 5200W
- AC power output of 3600W
- Power analyzer measurement



Pulsed solar simulator

- ⇒ Fast and precise STC power determination of PV modules, between measurements of exposed modules and electroluminescence measurements can be performed by the flasher system.

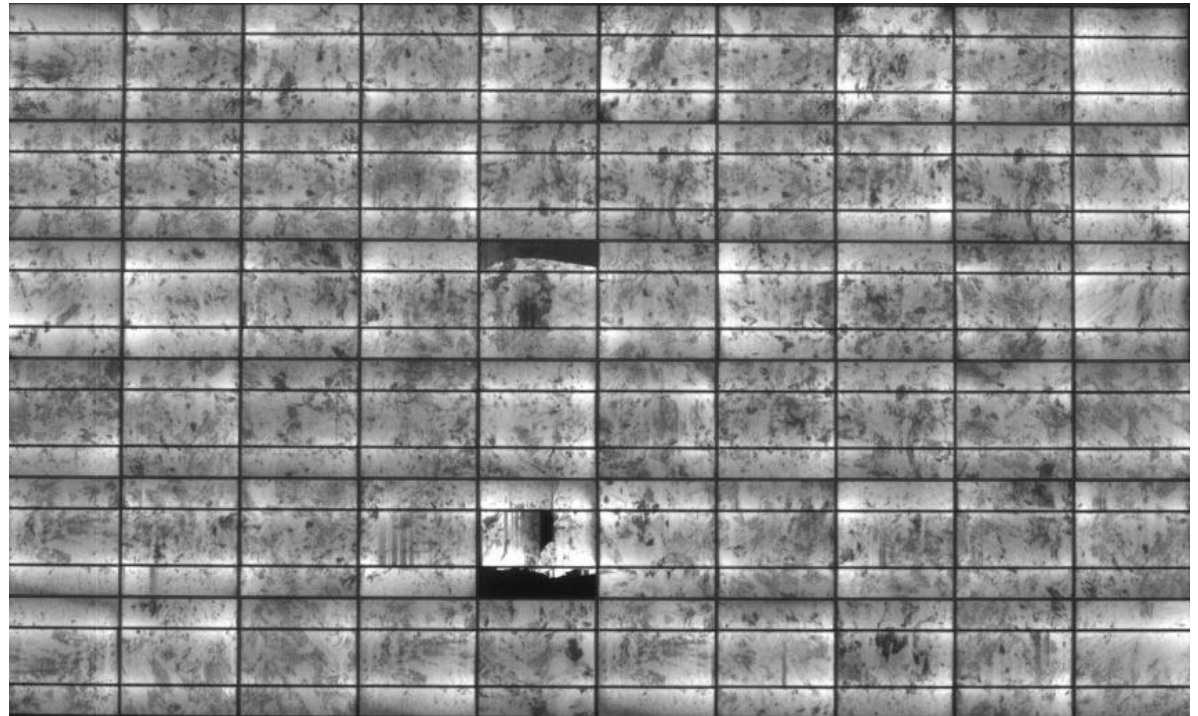
Advantages to steady state sun simulators:

- High maximum light intensity only during measurement
- No heating up of module or cell
- No cooling of light source or environment necessary
- Less power needed than constant light
- High flow-rate



Pulsed solar simulator

- Reverse current at PV module above its I_{sc} value
- High resolution camera in combination with high exposure times



Measuring system

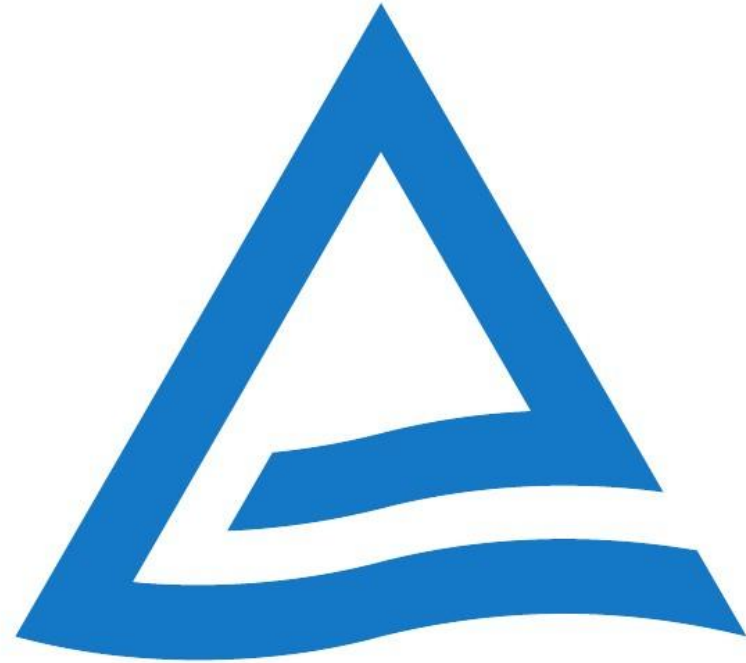
- Customized digital multimeter acts as data logger
 - standalone system
 - up to 360 measuring channels
- 4 wired PT100 temperature sensors
- Grid feeding electronic loads
 - No active cooling necessary
 - MPP tracking
 - IV curve measurement
- Stainless steel outdoor cabinet

Meteorological measurement system

Main components of meteorological station:

- Pyranometer
- Albedometer
- Reference cell (Si sensor)
- Combined ambient sensor
 - Ambient temperature
 - Ultra sonic wind speed and direction measurement
- Spectrometer system
 - 300 to 1100 nm
- UV sensor
 - UV A and B irradiance

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