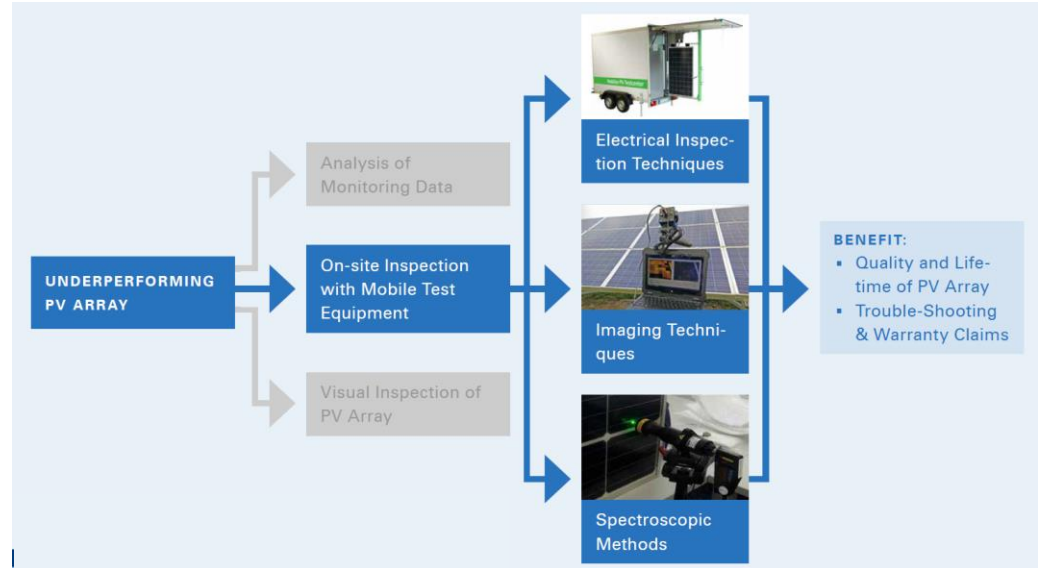


Motivation for using Mobile Test Equipment in PV



- On-site inspection methods are helpful tools to identify the drivers for underperforming PV power plants.
- **Particular strength:** Tests can be performed without dismantling PV modules and shipping them to a test laboratory ⇒ avoid transport risks and long PV systems down time.
- On-site inspection allows a **targeted failure analysis** by selecting suitable test methods from:
 - Electrical inspection techniques
 - Imaging techniques
 - Spectroscopic methods



Electrical Inspection Methods & Detectable Failures



Daylight I-V measurement of PV strings and PV modules



- Output power degradation
- Cabling issues
- DC wiring losses
- Shading and soiling effects
- Electrical mismatch of PV strings
- Bypass diode failures
- PID / LeTID on PV string level

Dark I-V measurement of PV strings and PV modules



- DC wiring losses
- Electrical mismatch of PV strings
- Bypass diode failures
- PID on PV string level

PVPS

Report IEA-PVPS T13-24:2021, April 2021

PV module characterization with mobile PV test centre



- Output power degradation
- Resistive losses
- Cell cracks
- Interruptions in the cell interconnection circuit
- Bypass diode failures
- Induced degradation (PID, LeTID)

PV plant testing vehicle for PV strings



- Performance ratio (PR) of PV power plant
- DC wiring losses
- Inverter efficiency losses
- Shading effects during the day
- Soiling & snow coverage effects
- Electrical mismatch of PV strings

Imaging Techniques & Detectable Failures



Drone-mounted electroluminescence & thermal infrared imaging of PV arrays



- Cabling issues
- Combiner box issues
- Cell cracks
- Bypass diode failures
- Interruptions in the cell interconnection circuit
- Induced degradation (PID, LeTID)

UV fluorescence imaging



- Cell cracks
- Distinction between older and younger cell cracks
- Differentiation of used encapsulation and backsheet materials

Daylight electroluminescence imaging



- Cell cracks
- Interruptions in the cell interconnection circuit
- Induced degradation (PID, LeTID)
- Bypass diode failures

Outdoor photoluminescence imaging of PV modules

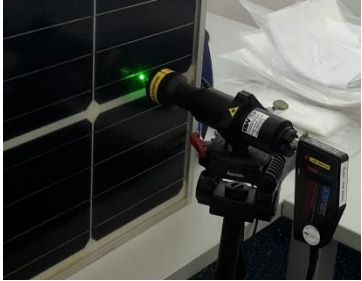


- Cell cracks
- Interruptions in the cell interconnection circuit
- Induced degradation (PID, LeTID)
- Bypass diode failures

Spectroscopic Methods & Detectable Failures



Spectroscopic methods for polymeric materials



- Polymer degradation
- Differentiation between different types of encapsulation and backsheet materials (polymeric footprint of PV module)

Electrical impedance spectroscopy of PV strings



- Non-operative PV modules
- Insulation/ground failures
- Bypass diode failures
- Induced degradation (PID)