

PV MODULE SERVICE OVERVIEW



Mitigate Risk and Optimize Your PV Module Investment

CEA performs quality assurance work before, during and after the production of PV modules, conducting 6 main activities, that are necessary to ensure pre-installation quality.



CEA's Services are Designed to Mitigate Risk

PROJECTS

- CEA has completed factory audits, in-line production monitoring, and product pre-shipment inspections at over **150 supplier** production facilities
- Over **35 GW** of module quality assurance (QA) engagements

Product Type:	Crystalline silicon, glass/backsheet multi	Product Type:	Crystalline silicon glass/backsheet mono PERC module, 390 W
OA Services	module, 290 W Inline Production Monitoring (IPM), IPQC	QA Services:	Pre-Shipment Inspection (PSI), Inline
QA JEI VICES.	(In-line Production Quality Control)		Production Monitoring (IPM) Issue
Issue Description:	Massive soldering peel strength test	Issue Description:	Very high EL defect rate due to
Kolm Sol Note Note	failures resulted in line stoppage		microcracks, extensive bad soldering on
		6	rear side evading EL detection, bad
	Good soldering is critical for module	1	practices at the tabbing / stringing station
	reliability, as weak soldering bonds will	CEA Value Added:	CEA inspectors managed to bring the
	degrade in the field and will eventually		defect rate from peaks of 50% down to
	result in hotspots and total failures. CEA		5%. CEA rejected 57,000 modules (22
	auditors suggested the supplier to shut down and repair the stringer. Production		MW) with high microcrack defect rates and suggested the supplier to improve
	resumed without major disruption to the	EL defectivate in line #1.	rear side inspection for weak soldering
	project schedule and without		instances. Mitigating actions allowed
B 2.83 3.46 3.50 3.02 3.22 1.64 3.54 3.81 3.88 5.38 A 0.79 2.93 3.33 3.99 2.16 6000 3.72 4.81 3.23 3.39 Pair 6 B 2.47 1.39 1.89 2.68 4.73 3.39 3.56 6.001 3.72 4.81 3.25 1.09 Reject Polative 2385 6.73 7.73	compromising quality and exposing		production to continue, applying good
b 2.11 2.17 2.62 2.09 2.49 3.00 4.01 2.26 5.19 A 0.38 1.20 2.26 2.00 0.36 2.27 1.80 2.73 1.51 1.11 B 8 9 0 0.47 1.49 2.73 1.51 1.11 B 8 9 0 0.47 1.49 0.41 4 0.4 Peiject Peidablee 264 pcs B 8 9 0 0.35 8 0 0.4 Peiject Peidablee 264 pcs	client to long term risks.	Who that An	practices and ensuring high product
A 8 8 8 8 8 8 2.80 2.39 1.14 0.53 3.01		and the second sec	quality.
b i		mannin	
Product Type:	Crystalline silicon glass/backsheet mono	Product Type:	Crystalline silicon bifacial double glass
	PERC module, half-cut cell, 400 W	Product Type:	mono PERC module, 380 W
QA Services:	PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI)	Product Type: QA Services:	mono PERC module, 380 W Inline Production Monitoring (IPM)
	PERC module, half-cut cell, 400 W	Product Type:	mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL
QA Services: Issue Description:	PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity	Product Type: QA Services:	mono PERC module, 380 W Inline Production Monitoring (IPM)
QA Services:	PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects	Product Type: QA Services: Issue Description:	mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift
QA Services: Issue Description:	PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity	Product Type: QA Services:	mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator
QA Services: Issue Description:	 PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found 	Product Type: QA Services: Issue Description:	mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL
QA Services: Issue Description:	 PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good 	Product Type: QA Services: Issue Description:	mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator
QA Services: Issue Description:	 PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good modules with the same serial numbers, in order to avoid rejection of the lot. Because CEA 	Product Type: QA Services: Issue Description:	 mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL inspections during the night shift. It is crucial to inspect cracked cells before lamination, when repair is feasible. CEA
QA Services: Issue Description: CEA Value Added:	 PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good modules with the same serial numbers, in order to avoid rejection of the lot. Because CEA auditors had captured EL images during 	Product Type: QA Services: Issue Description:	 mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL inspections during the night shift. It is crucial to inspect cracked cells before lamination, when repair is feasible. CEA highlighted risks to the client and
QA Services: Issue Description:	 PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good modules with the same serial numbers, in order to avoid rejection of the lot. Because CEA 	Product Type: QA Services: Issue Description:	 mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL inspections during the night shift. It is crucial to inspect cracked cells before lamination, when repair is feasible. CEA highlighted risks to the client and suggested internal improvements on the
QA Services: Issue Description: CEA Value Added:	 PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good modules with the same serial numbers, in order to avoid rejection of the lot. Because CEA auditors had captured EL images during production, which serve as unique "fingerprints," they were able to spot the false samples and reject the suspect lot completely. 	Product Type: QA Services: Issue Description:	 mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL inspections during the night shift. It is crucial to inspect cracked cells before lamination, when repair is feasible. CEA highlighted risks to the client and
QA Services: Issue Description: CEA Value Added:	PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good modules with the same serial numbers, in order to avoid rejection of the lot. Because CEA auditors had captured EL images during production, which serve as unique "fingerprints," they were able to spot the false samples and reject the suspect lot completely. CEA suggested mitigating actions on the	Product Type: QA Services: Issue Description:	 mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL inspections during the night shift. It is crucial to inspect cracked cells before lamination, when repair is feasible. CEA highlighted risks to the client and suggested internal improvements on the process and defective equipment (stringers). CEA continued to follow this defect in the quality review meetings
QA Services: Issue Description: CEA Value Added:	PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good modules with the same serial numbers, in order to avoid rejection of the lot. Because CEA auditors had captured EL images during production, which serve as unique "fingerprints," they were able to spot the false samples and reject the suspect lot completely. CEA suggested mitigating actions on the supplier, including personnel. Production continued without schedule disruptions, and the	Product Type: QA Services: Issue Description:	 mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL inspections during the night shift. It is crucial to inspect cracked cells before lamination, when repair is feasible. CEA highlighted risks to the client and suggested internal improvements on the process and defective equipment (stringers). CEA continued to follow this defect in the quality review meetings with the supplier to ensure the
QA Services: Issue Description: CEA Value Added:	PERC module, half-cut cell, 400 W Pre-Shipment Inspection (PSI) Tampering with PSI integrity, by falsification of module identity During PSI CEA randomly samples and inspects modules to decide lot acceptance. During the short interval of sample preparation, the supplier secretly inspected the sample lot, found excessive defects and produced new, good modules with the same serial numbers, in order to avoid rejection of the lot. Because CEA auditors had captured EL images during production, which serve as unique "fingerprints," they were able to spot the false samples and reject the suspect lot completely. CEA suggested mitigating actions on the supplier, including personnel. Production	Product Type: QA Services: Issue Description:	 mono PERC module, 380 W Inline Production Monitoring (IPM) High microcrack rate due to EL inspections not occurring during night shift CEA auditors found that the operator was not conducting pre-lamination EL inspections during the night shift. It is crucial to inspect cracked cells before lamination, when repair is feasible. CEA highlighted risks to the client and suggested internal improvements on the process and defective equipment (stringers). CEA continued to follow this defect in the quality review meetings

Clean Energy Associates (CEA), a solar and storage technical advisory firm, provides quality assurance and independent engineering solutions worldwide. We serve financial institutions, project developers, EPCs, IPPs, and power plant owners. From our base in China, CEA's quality control engineers travel worldwide to conduct upstream in-factory technical evaluations, including factory audits, production monitoring and pre-shipment product inspections. Our US-based product management and engineering (IE/OE) teams provide support throughout the project life cycle, from upstream supply chain management and supplier benchmarking, to downstream system design, construction, commissioning, performance assessment, re-power and optimization as well as warranty support. We serve the solar and storage industries through our expertise in PV modules, racking, inverters and energy storage systems. Since 2008, CEA has reduced buyers' risks and improved returns on investments via quality assurance, technical and financial due diligence and engineering services.

As technical advisors, we provide procurement and investment confidence through risk mitigation to key stakeholders in solar and storage projects worldwide