



ASTRONERGY

Quality Management and Reliability System

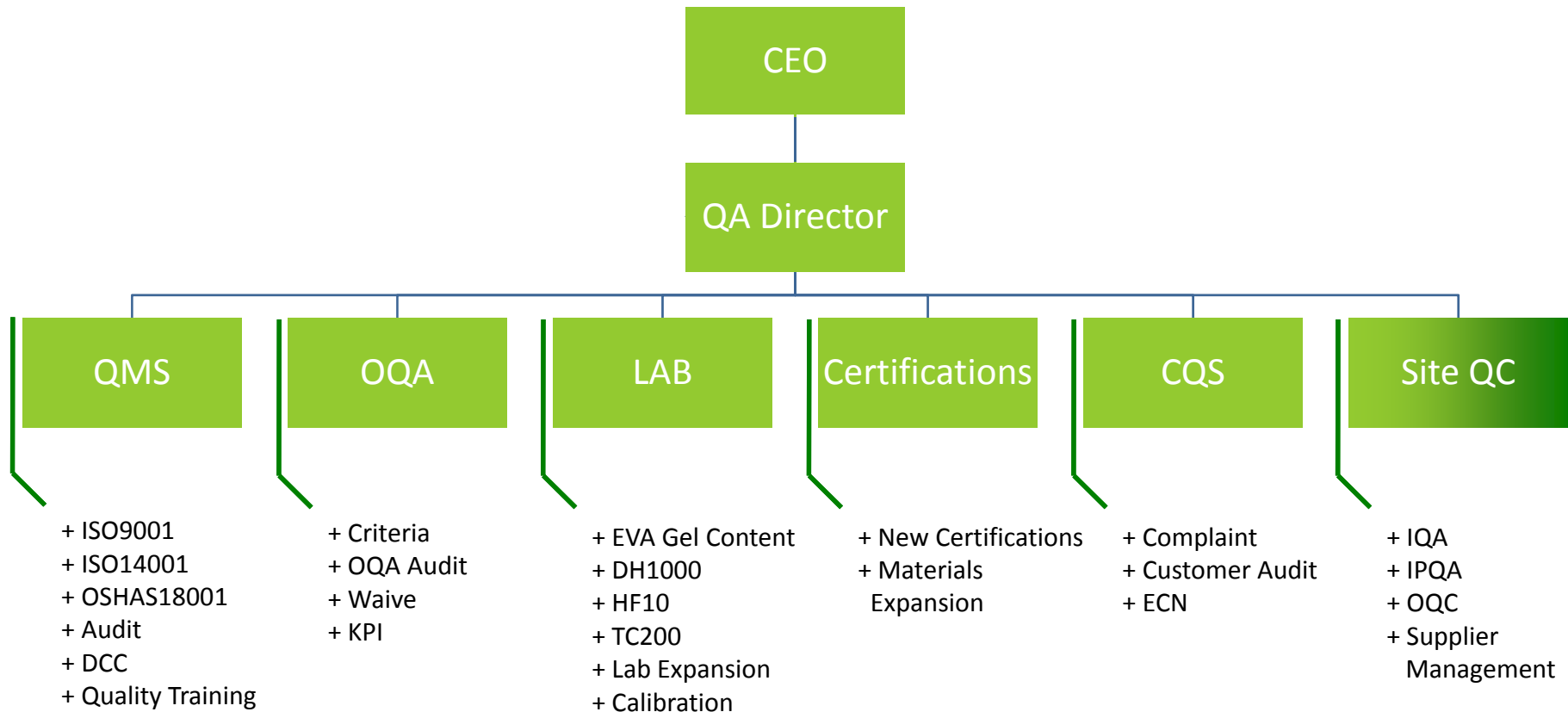
Quality Assurance Department
Sep 2013



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QA Organizational Chart

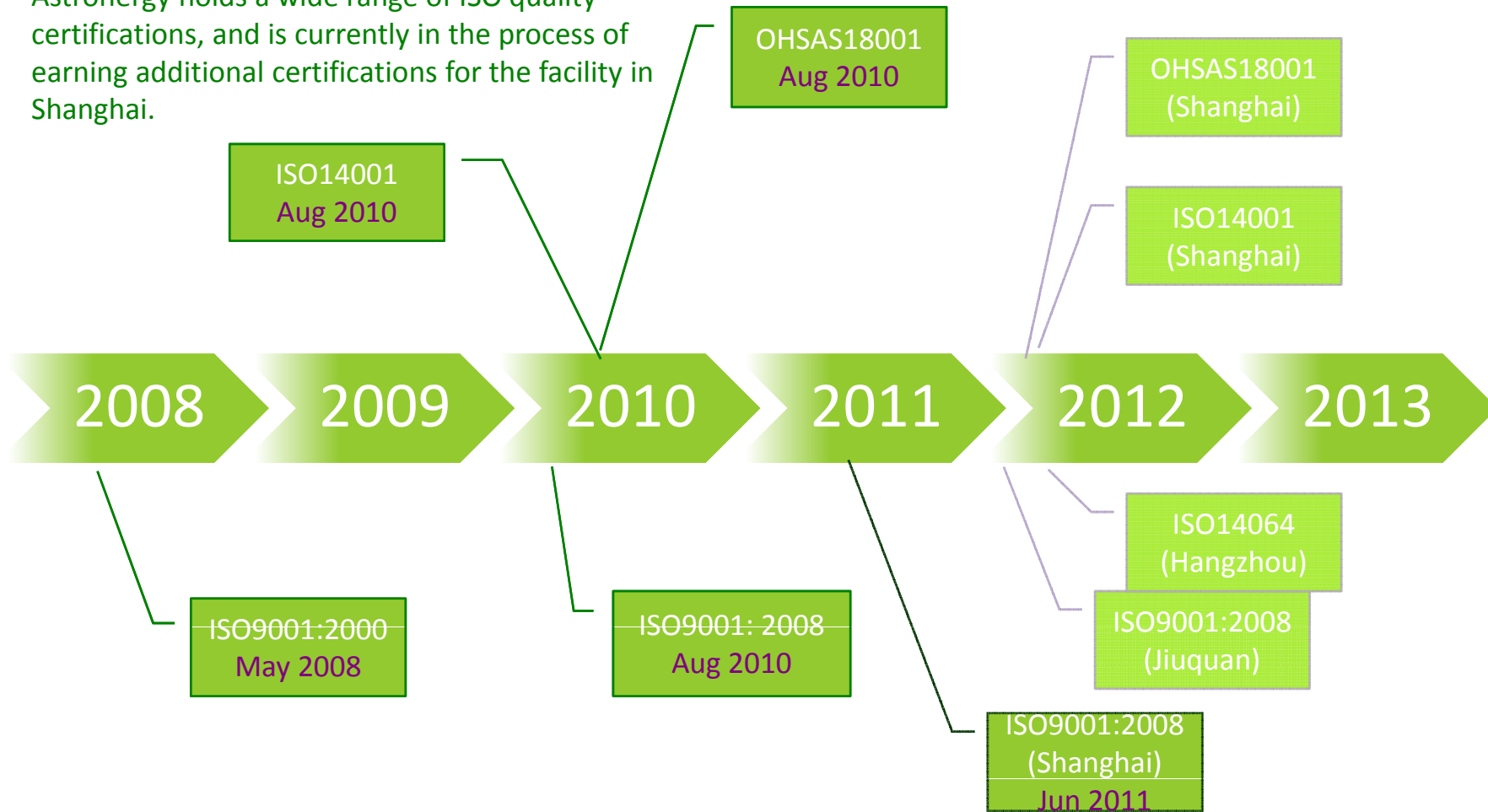
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ISO Qualification Roadmap

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Astronergy holds a wide range of ISO quality certifications, and is currently in the process of earning additional certifications for the facility in Shanghai.



Monocrystalline Module Certifications

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Module	TUV	CSA	CEC	FSEC	MCS	KEMC O	JET	CGC	CE
CHSM 5612M	→	→	→	→	→		→	→	→
CHSM 5611M	→	→							→
CHSM 5610M	→								→
CHSM 5609M	→								→
CHSM 5409M		→						→	→
CHSM 6610M	→	→	→	→	→	→	→	→	→
CHSM 6609M	→	→	→					→	→
CHSM 5612M BL	→	→	→						→
CHSM 6610M BL	→	→	→						→



Polycrystalline Module Certifications

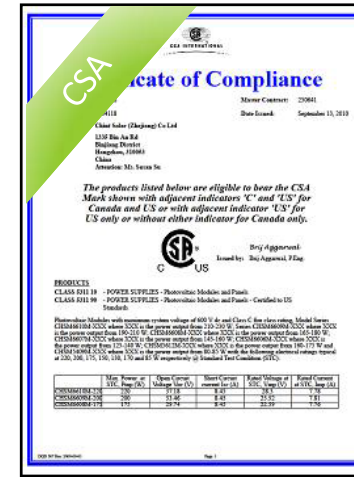
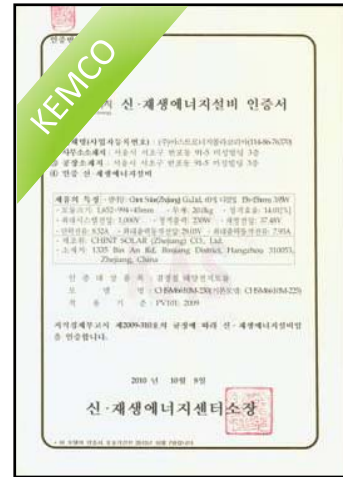
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Module	TUV	CSA	CEC	FSEC	MCS	KEMCO	JET	CGC	CE
CHSM 6612P	→	→	→	→		Sep.13	→	→	→
CHSM 6610P	→	→	→	→	→	→	→	→	→
CHSM 6609P	→	→		→				→	→
CHSM 6608P	→	→						→	→
CHSM 6607P	→	→						→	→
CHSM 6606P	→	→						→	→



Module Certifications

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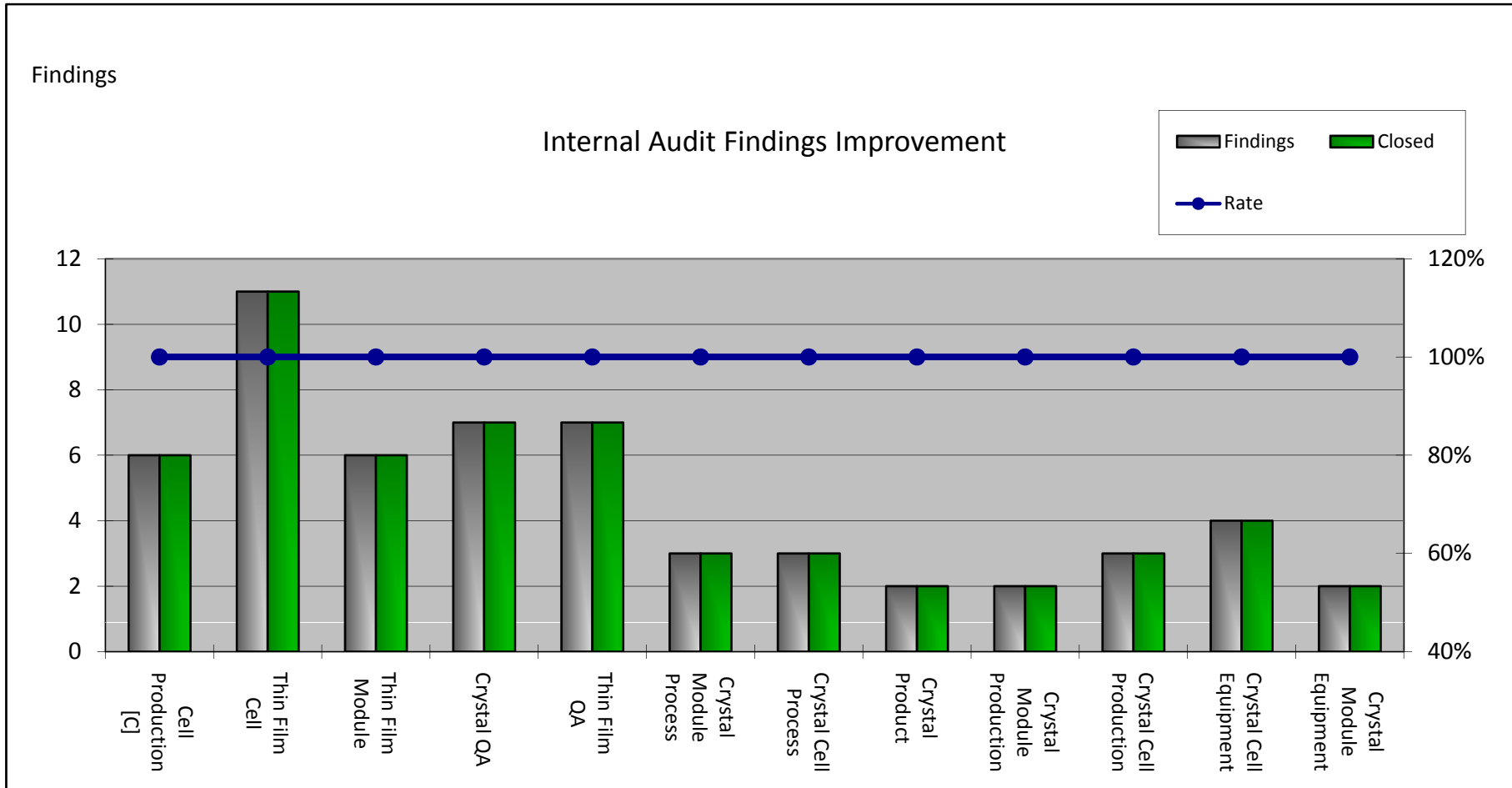
Internal Audit

- Once per year, covering all relevant departments
- Functional audit every 2 weeks: targets specific departments, processes and systems
- QA follow-up: implement preventative actions, evaluate effectiveness

External Audit

- ISO9001 GAC Audit- Every Year
- TUV Manufacturing Audit- Every Year
- CSA Manufacturing Audit- Every Quarter
- Customer Audit- Upon Request
- QA follow-up on corrective and preventative actions

System Audit Examples



Supplier Management System

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Raw Material
Quality
Assurance

- IQA
- Supplier Audit

New Supplier
Qualification

- Request
- Evaluation
- Qualification

Continuous
Improvement
of Suppliers

- Quality Issue
- Ranking

For each material, documented specifications are available and are sent to qualified suppliers to ensure the quality of the raw materials.



Supplier Management- c-Si

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Material	Item for Inspection	Inspection Point
String Cross Connectors	Packaging	IQA
	Dimension	IQA
	Resistivity	IQA
Ribbon	Packing	IQA
	Surface	IQA
	Dimension	IQA
	Resistivity	IQA
	Welding Strength	New Material
	Plasticity	New Material
Silica Gel	Packing	IQA
	Fastness	New Material
	YI Test	New Material
	UV-test	New Material
	DH	New Material
	Solidification Test	New Material
Frame	Packing	IQA
	Surface	IQA
	Dimension	IQA
	Film THK	IQA
	Mechanical Load	New Material
Backsheet	Packing	IQA
	Surface	IQA
	Dimension	IQA
	Peel Strength	IQA
	Adhesive Strength	New Material
	UV-test	New Material
DH	New Material	

Material	Item for Inspection	Inspection Point
Cell	Packaging	IQA
	Dimension	IQA
	Peel Strength	IQA
	Cell Degradation	IQA
	Efficiency	IQA
Glass	Packing	IQA
	Visual Defects	IQA
	Dimension	IQA
	Mechanical Strength	IQA
	Tempered Index	IQA
	Light Transmittance	IQA
EVA	Fe	IQA
	Packing	IQA
	Visual Defect	IQA
	Dimension	IQA
	EVA Gel	IQA
	Peel Strength	IQA
	Shrink Rate	New Material
	YI	New Material
	UV-test	New Material
	DH	New Material
Frame	Packing	IQA
	Visual Defect	IQA
	Dimension	IQA
	Peel Strength	New Material
	Break Strength	IQA



Fab Environment

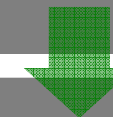
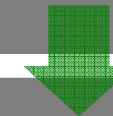
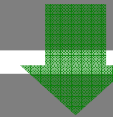
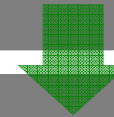
- Temperature
- Humidity
- Cleanliness
- DI Water

Product Compliance

Daily Equipment Check

Procedural Compliance

MES & Record



OQA Audit

Astronergy conducts an OQA Audit to ensure that delivered products meet our customers' requirements.

Items	Inspection Point	Frequency	Acceptance Criteria	Inspection Method
Material Consistency	Production Requirement Issued	Every Lot	Same as materials in BOM list	Visual Inspection
	During Production	Per Shift	Same as materials in BOM list	Line Audit
Visual Appearance	Before Packaging	Acc. To AQL Level 2 Standard	AQL 1.0	Visual Inspection
Power Output	After Packaging	20 pcs/ shift 20 pcs/type	+/-1.0%	Flasher
Micro-crack	Before Packaging	AQL Level 2	AQL 1.0	EL Image Check
	After Packaging	20 pcs/ shift 20 pcs/type	0 Ac/1 Re	EL Tester
Packaging	After Packaging	Acc. To AQL Level 2 Standard	AQL 1.0	Visual Inspection
Special Requirements	Before Shipment	Per Shift	Meet Customer's Requirements	Line Audit



Equipment Quality Assurance

- Module Flasher certified AAA by NIM
- Light intensity uniformity (internal) checked weekly
- GRR evaluation every year
- Flasher comparison every month

Standard Sample

- TUV certified golden sample for each type of module calibrated every year
- 2nd standard samples used for daily flasher check every 2 hours
- EL test of 2nd standard sample every shift to ensure standard accuracy
- 2nd standard samples calibrated by golden sample every month

Manufacturing Execution System

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Product Traceability

- Lot History
- Process Recipe
- Material info

Equipment Management

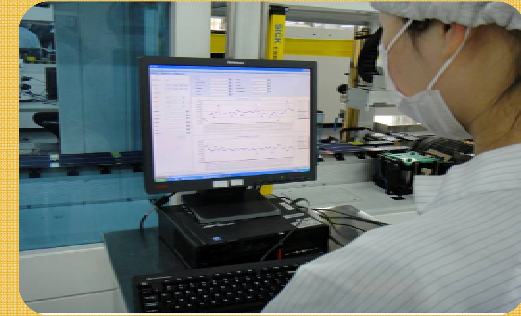
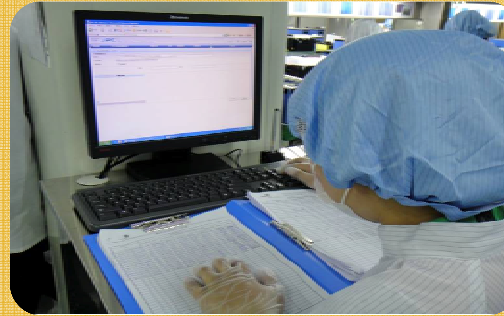
- Real Equipment Statutes
- Equipment PM Record

WIP Control

- WIP Tracking
- WIP Exception

Quality Data Analysis

- Daily Performance Report
- Non-conformance Record



SPC Chart

- Data Collection
- SPC Rules Setting

SPC Monitoring

- Cpk Calculation
- OOC Points and Automatic E-mail
- OOC Points Analysis

SPC Review

- Engineer Daily Review
- Monthly SPC Meeting

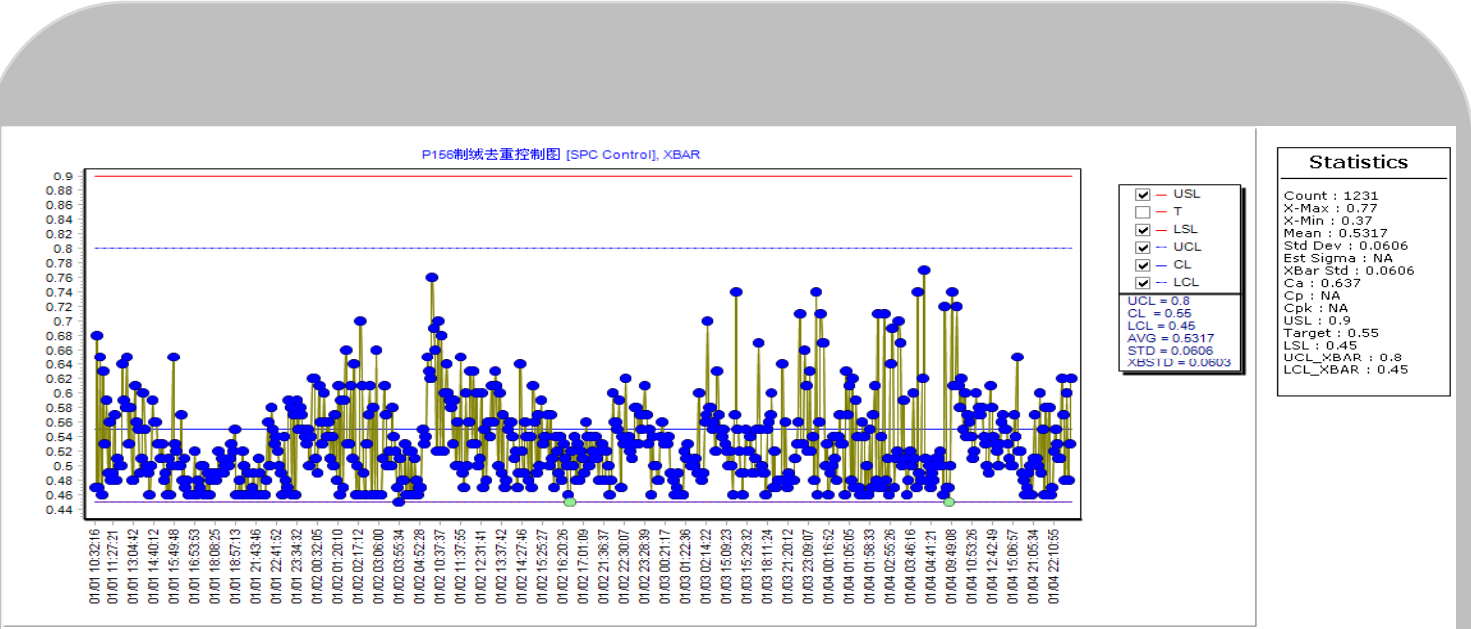
OOO/OOS & CPK Review

ID	Cell Type	Items	Cpk		Actions
			Jan	Feb	
4261	156P-2BB	P156 Resistivity	1.90	2.51	
4323	156P-2BB	P156 Weight Removal	0.79	0.58	P156 JJC, RENA control limit and specifications limit to be confirmed twice
4461	156P-2BB	P156 in Oxide Weight Removal	1.89	1.61	
4362	156P-2BB	PECVD-01 PEVCD Thickness	1.62	1.48	
4361	156P-2BB	PECVD-01N	1.17	1.85	
4393	156P-2BB	PECVD-08 PECVD Thickness	2.01	0.80	Thickness and N value is abnormal when close to PM time. Process and Equipment must be reviewed for PM frequency.
4392	156P-2BB	PECVD-08 N	1.07	1.93	
4504	156P-2BB	P156-2BB-line#1 Backside Weight	1.44	2.34	
2848	156P-2BB	P156-2BB-5 line # Busbar Weight	3.26	2.64	

OOO/OOS and CPK are reviewed on a monthly basis. Root causes and actions are defined when OOO/OOS occurs. Improvement plans are devised for items with poor CPK performance.



SPC Chart Samples

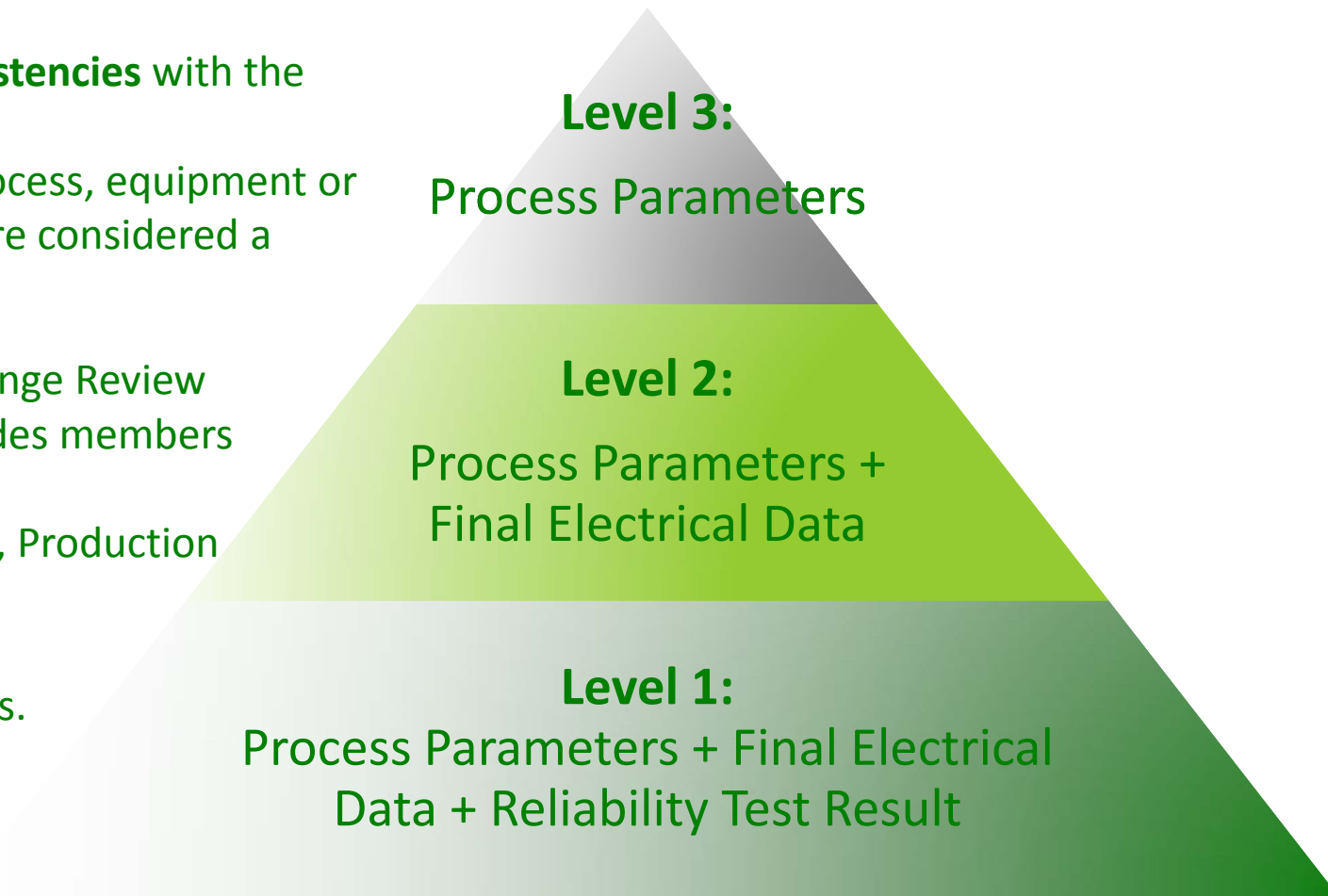


Process Change Protocol

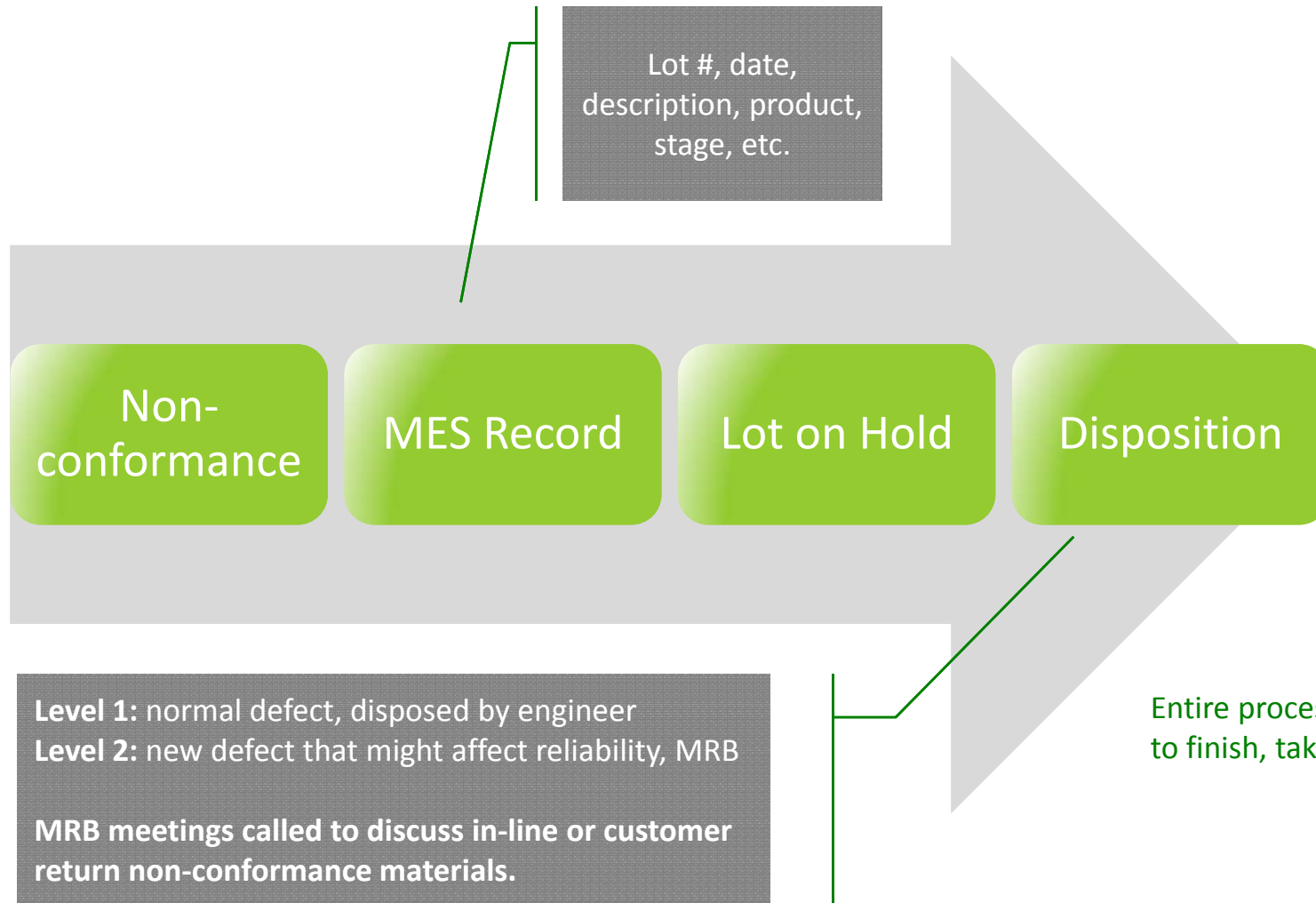
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Any inconsistencies with the controlled product, process, equipment or standards are considered a change.

Process Change Review Board includes members from the QA, Process, Production and equipment departments.

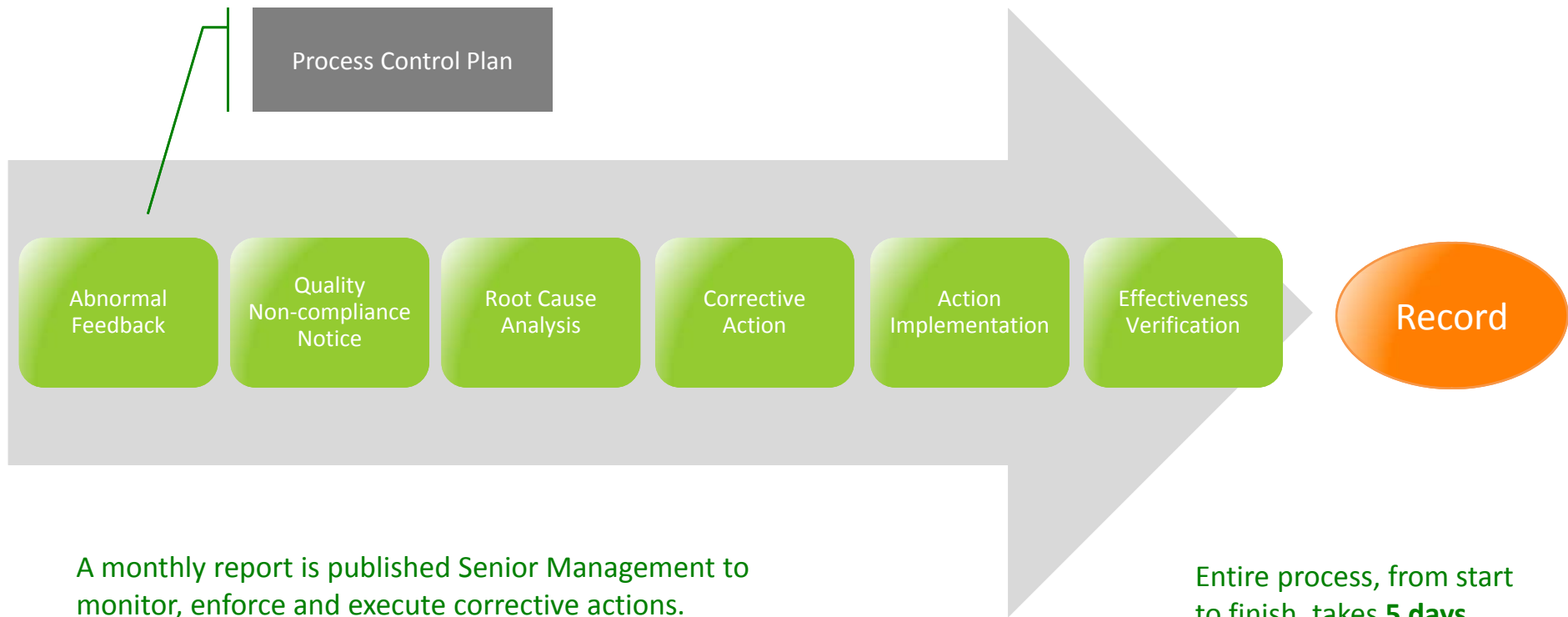


Non-conformance Control



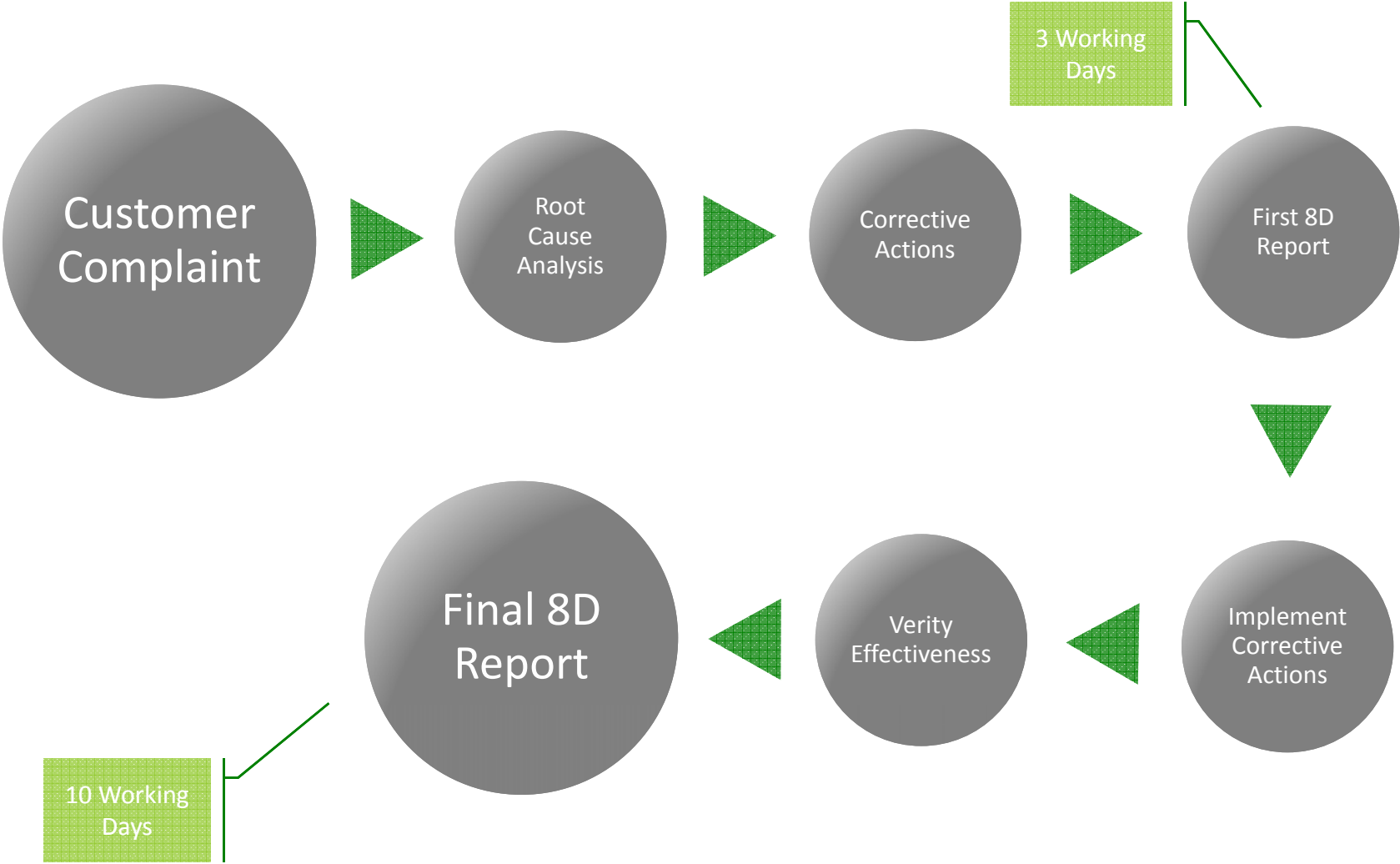
Process CAR Method

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Customer Complaints

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Quality Assurance in Module Process

No.	Test Item	Frequency	Test Machine	Measurement Method
1	Insulation	100%	Insulation Test Machine	3600V & 1s Insulation Resistance ≥ 40 Mohm.m ²
2	Powermax	100%	Spire 4600SLP	Temperature 25+/-1def I-V Test
3	EL Test	100% before lamination and OQA	EL Tester	According to EL criteria
4	Visual Inspection	100%	Naked Eye	1000L lux
5	Wet Leakage Current	Every Day	Insulation Test Machine	IEC 61215 10.15
6	UV Test	Every 6 months new silica/EVA	UV Tester	IEC 61215 10.10
7	TC200	Every 6 months	Temperature Test Chamber	IEC 61215 10.11
8	HF10	Every 6 months	Temperature Test Chamber	IEC 61215 10.12
9	HF50	Every year	Temperature Test Chamber	Internal Procedure
10	DH1000	Every 6 months	Temperature Test Chamber	IEC 61215 10.13
11	DH3000	Every year	Temperature Test Chamber	Internal Procedure
12	Outdoor Exposure	Every 6 months	Flasher	n/a
13	Mechanical Load	New glass/ Frame/ Silica Gel	n/a	UEC 61215 10.16
14	EVA Gel Content	Every day	Weight Tester	Internal Procedure
15	Ribbon Peel	Per lot (Paste)/ per shift	Pull Tester	Internal Procedure
16	Backsheet Peel	Every week	Pull Tester	Internal Procedure
17	EVA/Backsheet/Glass Peel	Every week	Pull Tester	Internal Procedure



Reliability Testing Equipment

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ML (2)



Mechanical Load testing

Wet Leakage



Wet Leakage

PCT (1)



Accelerated Life Testing

Cut Susceptibility Test (1)



Backsheet Cut Susceptibility

Fluke (2)



Hot Spot Test



UV Tester (1)

UV Preconditioning Test



Temperature Chamber (8)

DH1000/TC200/HF10



DSC (1)

EVA Gel Content

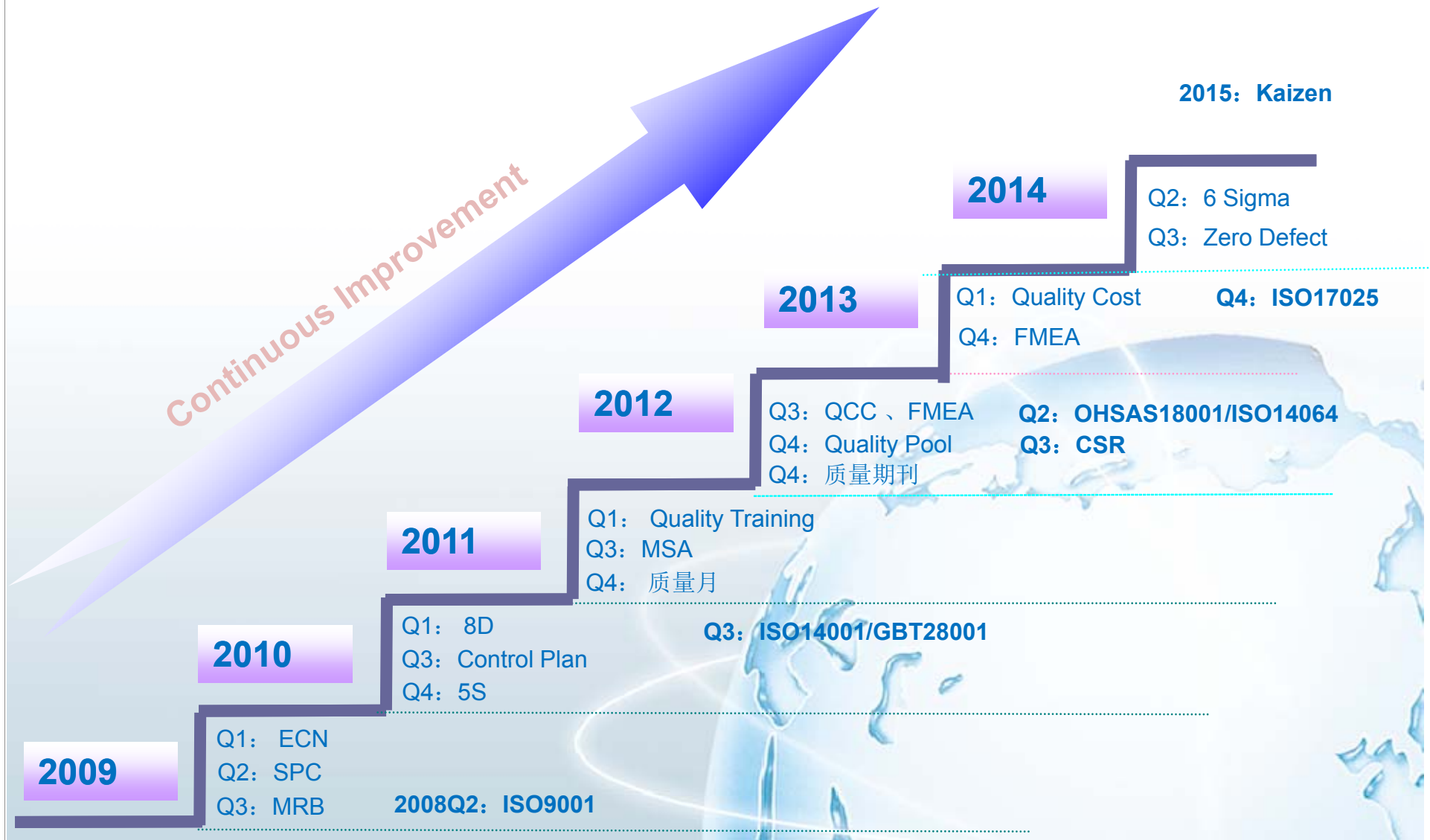


Puller (1)

Peel Test

Quality Active Roadmap

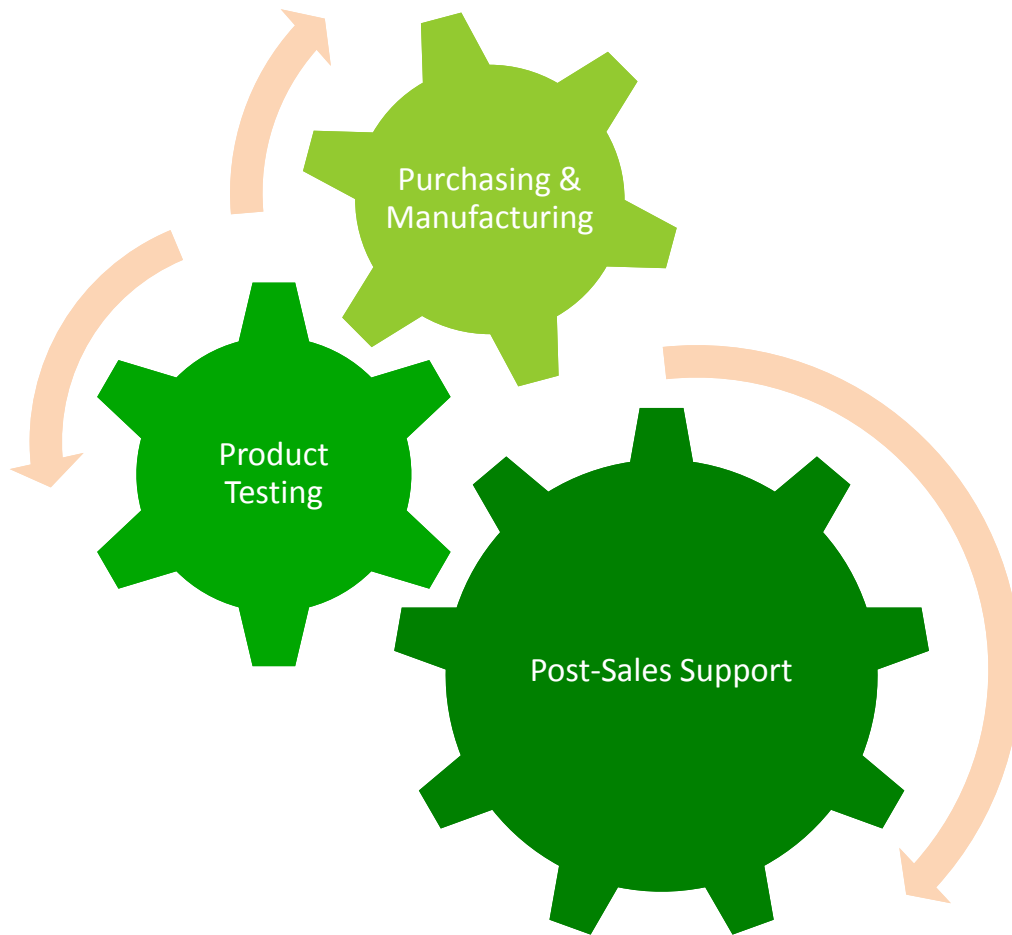
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Quality Management Summary

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Astronergy's Quality Assurance System permeates every step of the photovoltaic value chain – from raw material supply to post-sales support.



Purchasing & Manufacturing: Strict regulations on supplier quality, regular audits and a comprehensive international network of qualified suppliers.

Product Testing: Internal testing up to and exceeding IEC and UL standards, with a comprehensive array of both physical (load, stress, etc.) and operational (cell and module degradation) tests. Each product is visually inspected according to a detailed criteria and 100% EL testing before shipment.

Post-Sales: Industry standard warranty policies and a set customer complaint procedure with a 3-day turnaround. Ongoing quality assurance efforts led by a dedicated team at Astronergy.



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