Photovoltaic Module Durability Testing Program

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Photovoltaic Module Durability Testing Program

*Atlas 25^{PLUS}*
The Premise

The economics of PV is based on modules performing reliably for 25+ years.

Weather durability performance data is needed:

- for product development decisions
- to avoid catastrophic failure
- to determine and support warranty
- to provide assurance to financial stakeholders
Typical Claims

The warranty period for material and processing errors is 60 months.

Solon – Produktgarantie von 2 auf 10 Jahre erhöht

SunClass High Power Photovoltaic Modules
- SC 170-72M
- SC 175-72M
- SC 180-72M
- SC 185-72M

SunModule 3
- SW 200/205/210/215/220/225 poly

25 Jahre Leistungsgarantie
- 5 Jahre Produktgarantie

www.sunclass-solar.de
E-Mail: info@sunclass-solar.de, Tel. 040/30858180

ATLAS
MATERIAL TESTING SOLUTIONS
The Problem

“Outdoor testing is a must, but it takes much too long to be of much use as a decision maker. We clearly can not wait 25 years or even a significant fraction of 25 years to introduce a new product. Therefore we must develop and utilize accelerated tests to qualify these new products.”

Source:
Characteristic Failure Modes

- Delamination
- Cracking
- Rusting
Characteristic Failure Modes

Yellowing

Overheating

Delamination & corrosion

Photon International, September 2009
“Remaining Challenges”

- 25 year warranty
- Ill-defined field conditions
- Harsh and varied outdoor conditions
- Materials used near their limits
- Limited acceleration factor ➔ long tests
- Large samples, small sample size
- Subtle polymer chemistry
- Cumulative effects, positive feedback loops

Source:
What is Known?


IEC Design Qualification Tests

e.g. IEC 61215, IEC 61646
IEC Tests vs. Long Term Durability Tests

Hypothetical Bathtub Curve

- **Atlas 25** plus Life Testing
- Screening

Time ———>
Environmental factors influencing PV performance

- Solar radiation
  - Heat / Cold Temperature changes, shock
  - Mechanical factors, e.g. abrasion by sand, dust, hail
  - Water: air humidity, rain, condensation, snow, ice
  - Salt water, mist, acid rain
  - Man-made and natural air pollutants, e.g. NO\textsubscript{x}, SO\textsubscript{x}, soot, dust, NH\textsubscript{3}
  - Oxygen, O\textsubscript{3}
  - Biological factors, e.g. mildew, algae, bird’s droppings

Ageing (microscopic)

Property change (macroscopic): function, appearance

(Premature) failure

Source: Atlas Material Testing Technology LLC
The Reality of Reliability Testing

“To be accurate, an accelerated model of reliability needs to include interactions of stresses and their combined effects on lifetime. The stresses must include not only temperature, humidity and light, but cover the full range of thermal cycling, exposure to chemical contaminants and any external or internal load. Stresses should be applied in a cycling manner and all specimens should be exposed to all of the appropriate stresses.”

Bill Murray has held Reliability Engineering positions at 3M where he co-founded the Weathering Resource Center, and developed ANSI and ISO accelerated test methodology for electronic data storage. He has chaired ASTM subcommittees on Service Life Predictions.
A comprehensive accelerated weathering protocol designed to subject PV modules to the key environmental stresses likely to be encountered in long term service.
The Atlas 25PLUS Testing Process

Module A
One PV module is run through the Atlas 25PLUS testing sequence over the course of 12 months.

1. UV Conditioning
2. Salt Spray Corrosion
3. Condensing Humidity
4. Solar/Thermal/Humidity Cycle
5. Solar/Thermal/Humidity/Freeze Cycle
6. Arizona Solar Tracking including peak summer
7. Initial, final and multiple interval measurements
Visual inspections, IV curves, infrared thermographs and digital photography included.
8. Results and data
Completion of the Atlas 25PLUS program provides test data that would be otherwise unattainable with current test methods.
A report details all data, images and analyses at the end of the one year test sequence.

Modules B & C
Two modules provide baseline data using outdoor solar tracking in subtropical South Florida and the arid Arizona Sonoran desert for one year.

To learn more about the Atlas 25PLUS Program, contact your local Atlas Sales Representative or visit us online at www.solardurability.com
Atlas 25PLUS Durability Test Program

Atlas 25Plus™ “global composite” environmental test cycle
(other climates available)

1 module FL 1 module AZ

1-year solar tracking South Florida & Arizona
Atlas 25PLUS Durability Test Program

Atlas 25Plus “global composite” environmental test cycle
(other climates available)

- UV conditioning: 30 days 30 kWh/m² UV
- Salt spray corrosion: 400 hours
- Condensing humidity: 125 hours

\[ \{ \text{22 days} \} \]

- Solar – Thermal – Humidity Cycle: 7 days / 120 cycles
- Solar – Thermal – Humidity/Freeze Cycle: 3 days / 40 cycles

\[ \{ \text{Repeats 80 days} \} \]

- Arizona solar tracking including peak summer: 10 weeks peak Arizona tracking in May - July
- Balance of year tracking rack

Total test program duration: 12 months
Durability Tested

The value of Atlas 25Plus

The purpose of the Atlas 25Plus program is to extend the understanding of the effects of environmental exposure beyond the IEC Design Qualification tests which only account for "infant mortality", and into the realm of Service Life Prediction (SLP). Completion of the Atlas 25Plus program provides test data otherwise unavailable for manufacturers to validate their warranty and performance claims that their modules will last.

The Atlas 25Plus mark serves as a key product differentiator and provides customers and financial stakeholders with proof of independent third-party environmental durability testing by the recognized industry leader.
• The *Atlas 25\textsuperscript{PLUS} mark* is one important decision criterion for investors and wholesalers.

• The *Atlas 25\textsuperscript{PLUS} mark* creates trust on the consumer side.
Questions?

Thank You!