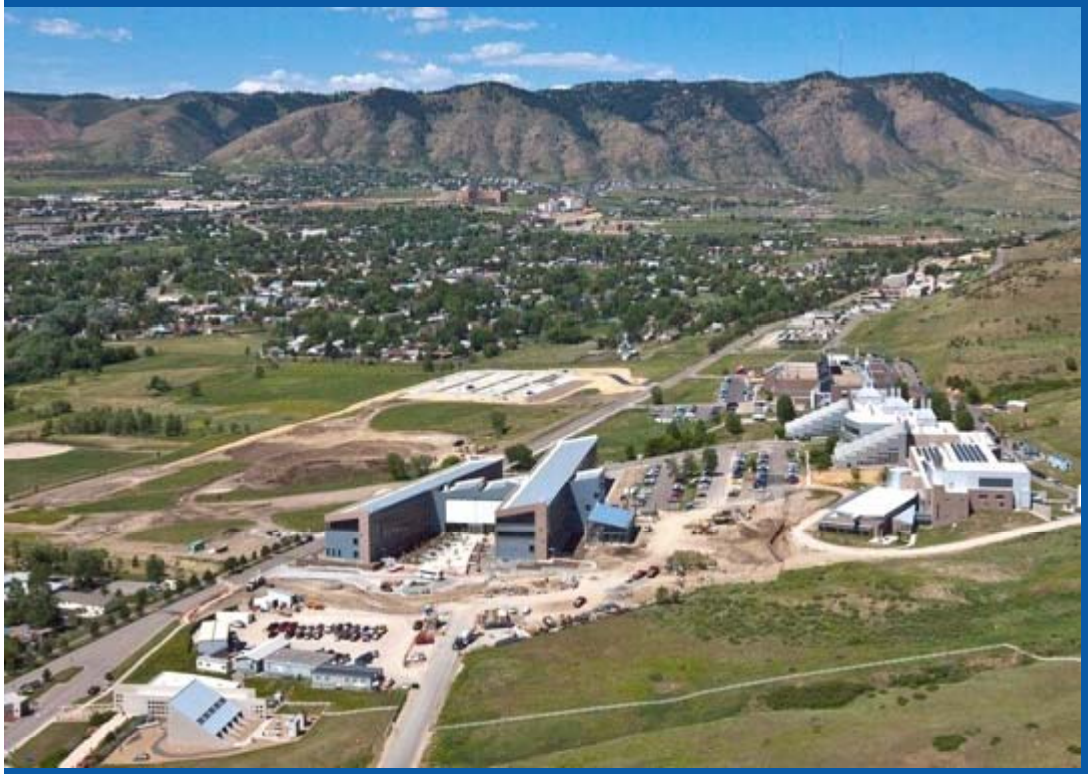
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

U.S. DEPARTMENT OF ENERGY

International PV Quality Assurance Task Force



Solar ABCs Meeting, Dallas, TX

Sarah Kurtz, John Wohlgemuth

NREL

Tony Sample

EC-JRC

Masaaki Yamamichi

AIST

James Amano

SEMI

Oct. 21, 2011

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

International PV Module Quality Assurance Forum

San Francisco, July, 2011

Goals:

1. Create a QA rating system to differentiate the relative durability of module designs

1) Compare module designs
2) Provide a basis for manufacturers' warranties
3) Provide investors with confidence in their investments
4) Provide data for setting insurance rates

2. Create a guideline for factory inspections of the QA system used during manufacturing.

Hosted by

NREL
AIST
PVTEC

Supported by

JRC
US DOE
SEMI PV Group

International PV Module Quality Assurance Forum

The PV QA Task Force was formed at the conclusion of the Forum and consists of five (six) Task Groups;

Task Group 1: PV QA Guideline for Manufacturing Consistency (leader Ivan Sinicco)
95 volunteers

Task Group 2: PV QA Testing for Thermal and mechanical fatigue including vibration (leader Chris Flueckiger)

Task Group 3: PV QA Testing for Humidity, temperature, and voltage (leaders John Wohlgemuth and Neelkanth Dhere)

Task Group 4: PV QA Testing for Diodes, shading and reverse bias (leaders Vivek Gade and Paul Robusto)

Task Group 5: PV QA Testing for UV, temperature and humidity (leader Michael Köhl)

Task Group 6: Communication of PV QA ratings to the community (leader David Williams)

157 volunteers for Task Groups 2-6

Roadmap-Goals and Milestones

- Goals: to create a single set of QA standards and guidelines.
  - A QA rating system
  - A manufacturing QA guideline
- Milestones (interim):
  - QA standards and guidelines for Si PV Modules
    - *Task Group proposal (s) to IEC TC82 WG2* — *Spring 2012*
    - Task Group proposal (s) to IEC TC82 WG2 — Fall, 2012
    - Testing under the international QA standard begins — Spring 2012.

- Meetings:
  - #1 International QA Forum @ San Francisco, USA — Jul.15-16, 2011
  - Introductory EU meeting @ Hamburg, Germany — Sep.8, 2011
  - APEC meeting @ San Francisco, USA — Sep. 15-16, 2011
  - APEC meeting @ Taipei, Taiwan — Oct. 12-13, 2011
  - #2 International QA Forum @ Tokyo, Japan — Dec. 7, 2011
  - #3 International QA Forum @ Europe — Spring, 2012

Task Group 1: PV QA Guideline for Manufacturing Consistency
(leader Ivan Sinicco)

Members, Leader: *Ivan Sinicco* (Oerlikon Solar ltd)
Region JP→Leader: *Yoshihito Eguchi* (Sharp)
Region Americas → Leader: *Alex Mikonowicz* (NN)
Region Europe → Leader: *Gunnar Brueggemann* (Oerlikon Solar ltd)
Region China → Leader: *Zhou Wei*

The regional task groups are divided into 4 sub-task groups identically in all regions, dealing with specific topics:

a) Incoming Material Acceptance Procedures
b) Traceability of products, materials and processes
c) Production Process control
d) Return of defective products, analysis and warranties

Next meeting: Oct. 11 (teleconference)

Task Group 2 Thermal and Mechanical Fatigue Including Vibration

Task Group 2: Thermal and Mechanical Fatigue including Vibration
(leader Chris Flueckiger)

Proposed Scope:

Failures of cell interconnects and solder bonds have been identified as a key cause of long-term failure of PV modules. The primary stresses affecting the failure rates have been shown to be thermal and mechanical. There is evidence that vibration during transportation can contribute.

Task Group 3: PV QA Testing for Humidity, temperature, and voltage
(leaders John Wohlgemuth and Neelkanth Dhere)
About a dozen members

Proposed scope:
Corrosion and charge movement, especially resulting from moisture ingress and electrical bias, can have dramatic effects on PV modules. There are many relevant processes and the interactions between stresses may make testing very difficult. There is also evidence that light can affect the failure rates, but a separate task group has been formed for this; the two will need to coordinate definition of scope.

- Do not plan to propose just increasing the time at 85/85.
- Plan to model the moisture ingress into various types of modules in different climates (humid/dry)
- Will likely have to evaluate the humidity/temperature dependence for different module constructions in different ways.
- Look for ways to pre-stress certain constructions (e.g. edge seals) before damp heat exposure.

Next call October 13 at 8:00 am MDT

Task Group 4 Diode, Shading & Reverse Bias

- **Team Leaders**: Vivek Gade (Jabil) and Paul Robusto (Intertek)
- **Proposed Scope:**

  The goal is to propose tests that intend to not only close the gaps in current qualification tests related to diode but go beyond it and find failure mechanisms to cover critical reliability aspects for long term performance.

- **Approach:**

  The strategy currently employed is as follows:

  – Form a strong team and encourage knowledge sharing through wiki page and meetings.
  – Literature search, share, review, and discuss.
  – Investigate potential diode related field failures available
  – Short list and prioritize tests to focus on.
  – Conduct initial experiments to explore failure mechanisms.
  – Present a tentative roadmap by the end of this year.

Task Group 5: PV QA Testing for UV, temperature and humidity
(leader Michael Köhl)

- Location dependent UV-stress under operation is not known.
- PV Module QA does not take into account the stresses caused by UV appropriately in the frame of the IEC type approval testing
- Test conditions (including suitable artificial UV radiation sources) are not sufficiently defined
- Investigation of degradation processes caused by UV and humidity
- Recommend suitable artificial UV radiation sources
- Proposal for Accelerated Life Testing
-

Task Group 6: Communication of PV QA ratings to the community (leader David Williams)

Proposed scope:

This group will discuss how to best communicate with PV customers, including financial investors, insurance companies, PV owners, etc.. The group can facilitate discussion between this broad spectrum of people and the engineers who are designing the tests. As the other task groups recommend test methods and the associated test results, this group will review these to confirm that the presentation of the results is in a format that is easily understood by the people wishing to access this information. This group may also proactively bring requests to the other groups regarding information that PV customers/investors are asking for

Want to Volunteer!

To volunteer for **Task Group 1**, individuals may contact the leader directly or request access to the website at

http://pvqataskforcemanufacturingqa.pbworks.com/

To volunteer for **Task Groups 2-6**, individuals may contact the leaders directly or request access to the website at

http://pvqataskforceqarating.pbworks.com/