NREL
NATIONAL RENEWABLE ENERGY LABORATORY

A Giant Leap Forward toward Quality Assurance of PV Modules

2012 PV Module Reliability Workshop

Golden, CO

Sarah Kurtz[1], John Wohlgemuth[1], Tony Sample[2], Masaaki Yamamichi[3]

[1]NREL

[2]EC-JRC
[3]AIST

Feb. 29, 2012

NREL/PR-5200-54567

Outline

- Motivation – Customers want to know quality of PV modules
- Two parts of quality assurance (QA) (during design and manufacturing phases)
- QA Task Force – formed July, 2011
- Plan for today:
  - Review IEC 61215 as a starting point
  - Review proposed new tests
  - Task Groups 2-5: introduction and updates
  - Discussions: consensus building; identification of issues

Motivation: the question on the street "How do I predict lifetime of PV modules?"

- Reliability engineer: How do I test to determine the number of years for the warranty?
- PV customer: How do I choose the PV module that will last longer?
- PV investor: How do I know that I'm making a safe investment of $1 billion (if the modules fail after 10 yr, the warranty will be worthless because the company will be gone)?
- Insurance company: How do I determine rates for insuring PV installations?
- PV Manufacturer: How do I differentiate my product from other products?

Two parts of Quality Assurance

1. Is the *design* durable for the intended application?
   - Depends on location (hot & humid; hot & dry, temperate, etc.)
   - Depends on mounting (close-roof mount runs hotter; partially shaded modules undergo different types of stress)
   - Depends on application (a customer may plan to resurface the roof 10 years from now and only cares about the modules lasting that long)
2. Are the modules *consistently manufactured*?
   - Could variations in the material composition or manufacturing processes result in premature failure of some fraction of the modules?

International PV Module Quality Assurance Forum was held in July, 2011, San Francisco

General agreement to work together on PV QA

Formed International PV QA Task Force:

Group of volunteers/professionals working toward a common goal

The PV QA Task Force formed at the conclusion of the Forum consists of six Task Groups:

Task Group 1: PV QA Guideline for Manufacturing Consistency (leaders Ivan Sinicco, Alex Mikonowicz, Yoshihito Eguchi, Wei Zhou, G. Breggemann)

140 volunteers; held meeting last night

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

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

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

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

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

230 volunteers for Task Groups 2-6

International PV Module Quality Assurance Forum

July, 2011, San Francisco

Formed International PV QA Task Force:

Goals of International PV QA Task Force:

1. ***To develop a QA rating system that provides comparative information about the relative durability of PV modules to a variety of stresses as a useful tool to PV customers and as a starting point for improving the accuracy of quantitative PV lifetime predictions.***
   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.**

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

Task Group 1: PV QA Guideline for Manufacturing Consistency met last night (Feb. 28th):

- The regional task groups are each working on a PV-specific version of ISO 9001:2008
- This will define an ISO 9001-like quality management system with technical specifics relevant to PV: e.g., documentation of control of solder-bond quality
- The procedure for turning this ISO-like document into a standard is not yet clear, but is being investigated; may involve ISO and/or IEC
- Chinese regional group is planning to complete their draft by the end of March
- It is currently envisioned that this certification would be a way to differentiate products, not be required for a baseline IEC 61215 certification. For example, an insurance company might reduce the rate based on adding the PV-specific ISO 9001-like certification

Introduction to Today – What can we accomplish today?

Challenge is to accomplish our goals quickly

- Many ideas
- Not enough experience/wisdom for the path to be clear

- We will need to work together effectively and pool the wisdom we do have!

- Move decisively on the information we have
- Plan to modify approach as more information becomes available

Introduction to Today

1. Current status: IEC 61215 – what it does and doesn't do
2. Overview of many test methods that are out there
   - IEC 61215 on steroids; Accelerated simulation of weather; New tests
   - Beware: Many details lead to much confusion
   - Listen: What makes each test method valuable?
3. Overview of status of the QA Task Groups 2-5
   - Listen: What are the questions that need to be resolved?

Lunch

4. Community input/discussion
   1. Discuss the value we found in the proposed tests – see hand out
   2. Consensus building – what can we agree about? – see hand out
   3. Your concerns/questions
   4. Next steps

Requirements for a comparative QA rating system

- Customer's perspective
  - #1 desire: A number that indicates the service life (would this be meaningful?)
  - Relevant to customers' application
  - Easy to understand, but sophisticated customers would like detail
  - Tests that do not add to the cost
- Manufacturer's perspective
  - Single set of tests (applied under ILAC: International Laboratory Accreditation Cooperation)
  - Tests that require minimal time and minimal expense
  - Ability to differentiate products
- Scientific perspective
  - Must be meaningful (based on data, not guesses)
  - Logical approach may be helpful

Today we are limited to a *comparative* test, but we want to lay the groundwork for *quantitative predictions* in the future

My requests to you for today and going forward:

- Keep your eye on the goal – inexpensive, comparative standards that correlate with field performance
- Look amongst us for wisdom of what is most useful to the community, setting aside personal agendas

- Take a giant leap forward toward creating comparative test standards that go “beyond” IEC 61215