

# PV Module Power Rating Requirements

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## Objective:

Develop a Solar ABCs Power Rating policy statement, establishing requirements for the procurement of PV modules for consumers, states and organizations providing incentives for photovoltaic systems in the United States.

## Goals:

The goals of this policy statement are to:

- Increase customer **awareness** of the potential for **discrepancy** between the nameplate rating and performance of delivered PV modules. Define a reasonable expectation for the consistency of these numbers;
- Increase customer **awareness** of the power ratings that are made available to them as a result of the **IEC 61853-1 standard**. Empower customers to better compare the performance of modules under a range of conditions;
- Improve the **bankability** and reduce the risk of investments in PV systems by tightening the tolerance on module ratings.



## Motivation for policy:

**Without** requiring a **power rating tolerance policy**, photovoltaic modules will continue to enter the domestic marketplace that may have a significantly **lower power** output than the module's rating indicates. This results in reduced performance of installed PV systems that will **not meet consumers' expectations**. If over-rating of modules continues to be an acceptable practice, the overall acceptance by the general population will be diminished and the overall movement towards solar energy jeopardized. In addition, without power rating data at various low/high irradiance and temperature conditions, the **energy collection predictions** for installed PV modules and systems **will not be accurate**.



# PAST

## Allowed nameplate tolerance in the Past

Measured power = Nameplate rated power **+/- 10%**

## Past practice by manufacturers (example)

Nameplate rated power: 100W

Measured power: > 90W ~ < 110W

## Reason for the past allowed tolerance

- Reproducibility error between test labs was high due to high measurement uncertainties!
- Modules were primarily used in the standalone systems

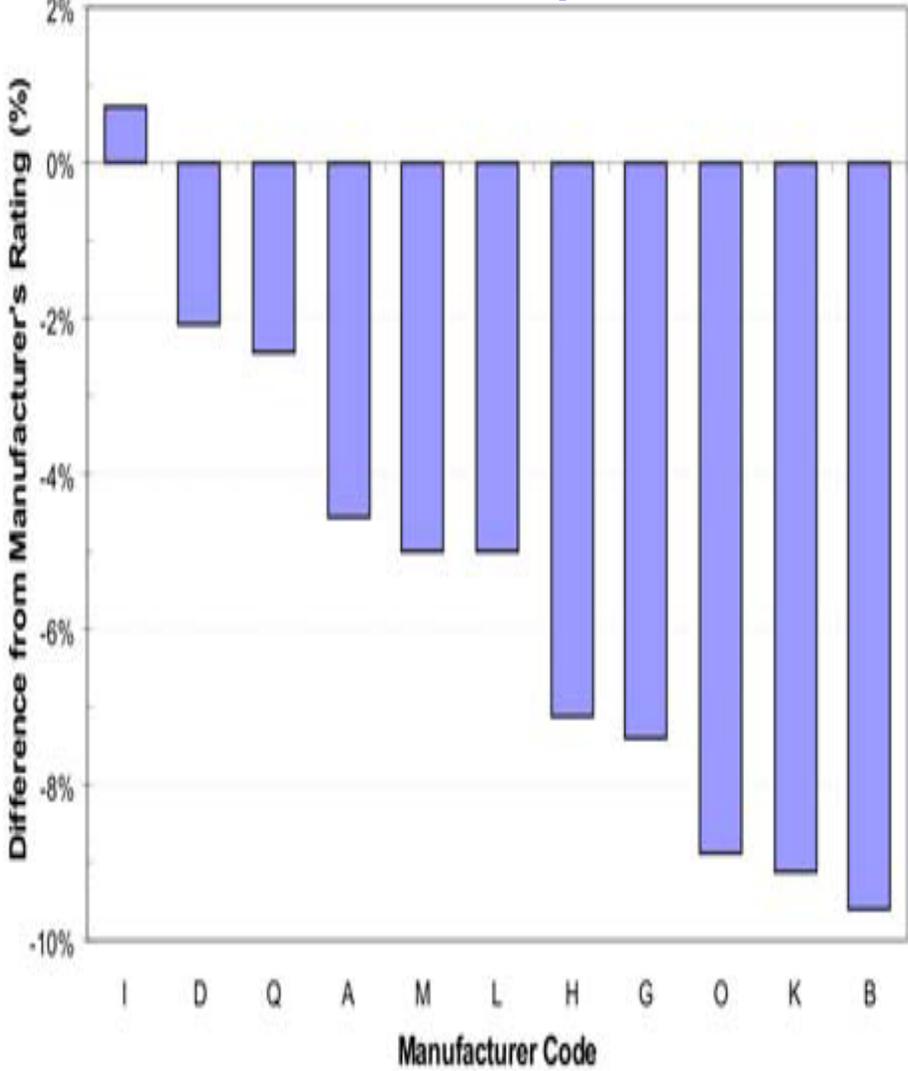
## Past market issue

- Measured power: Tended to be towards 90W but priced at 100 W (see FSEC's data next page)

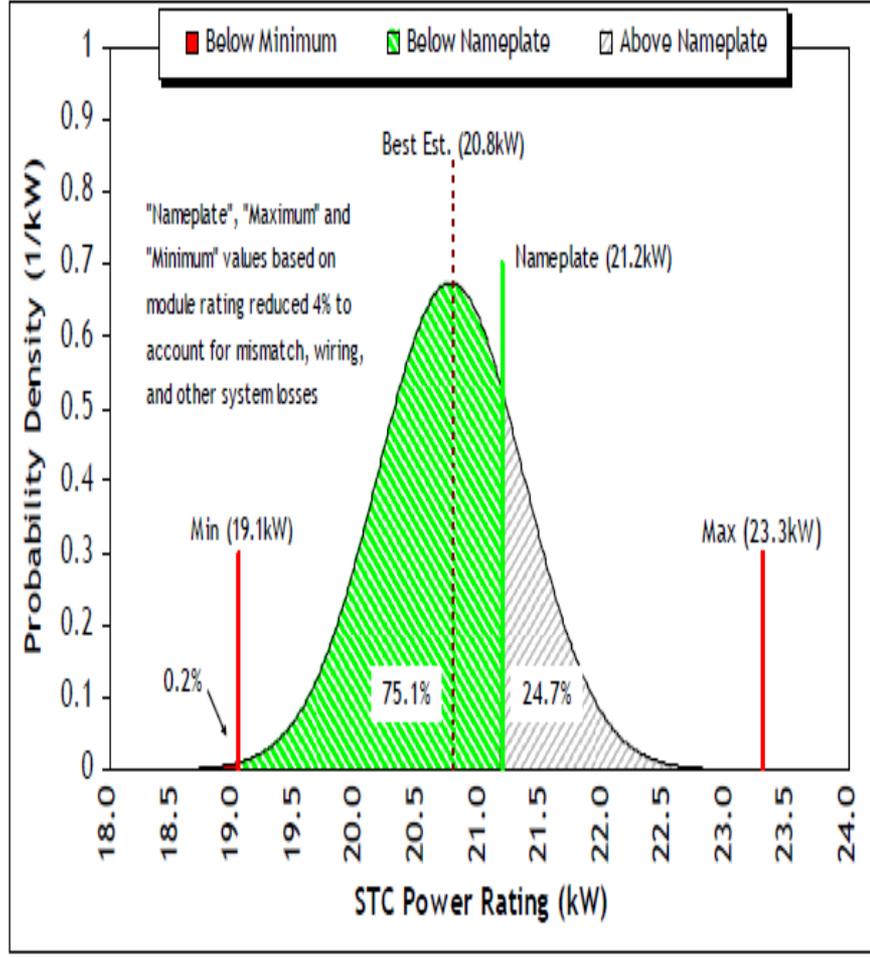


# Past market issue

## Modules: From open market



## Modules: From field



## *Solar ABCs' Previous Policy (November 2008)*

**“The permissible deviation from module nameplate output for current, power, and voltage for modules installed in the U.S. shall be  $\pm 5\%$ . A more detailed *Solar ABCs* policy shall be developed to address related issues such as stabilization, measurement uncertainty, warranties and other issues.”**



# PRESENT

- Reproducibility error between test labs is now **smaller** (for example, **+/- 3%** for c-Si; *see NREL's round robin data*)
- Nameplate tolerance is, typically, low (**+/- 3%** for c-Si) (*see manufacturers' nameplate tolerance data*)
- Independently measured power of power plant modules is equal to or higher than 3% below nominal (*see European power plant data from an independent lab*)



# Reproducibility Error – **SMALLER!**

## **NREL Round Robin Testing – 2006 (WCPEC4-2006)**

	<u>&lt;Pmax&gt;, W</u>	<u>NREL</u> pre	<u>SNL</u>	<u>ASU</u>	<u>FSEC</u>	<u>ESTI</u>	<u>LEEE</u>	<u>TUV</u>	<u>ISE</u>	<u>JET</u>	<u>NREL</u> post
<b>Mono-Si</b>											
SIE0577	66.84	-2.9	3.2	1.6	-4.2	0.4	-0.2	-0.2	0.8	1.3	-2.6
SIE0586	67.22	-3.2	2.9	1.3	-4.2	0.4	0.6	-0.6	0.7	1.7	-2.8
<b>Thin Film Si</b>											
AsP0123	51.54	-3.5	1.7	0.7		0.9	-1.4	0.3	0.8	-0.6	-2.4
AsP0247	52.87	-3.1	1.8	0.6		1.4	-1.5	0.1	0.6	-0.9	-2.1
<b>a-Si/a-Si:Ge</b>											
BPS4213	41.04	4.8	-0.3	2.3		-7.2*		3.3			1.8
BPS4223	36.82	3.7	1.8	3.7		-3.3*		-3.9			1.6
<b>a-Si/a-Si/a-Si</b>											
USSC234	19.24	3.2	-0.6	-0.2		-7.8*		9.1			-0.5
USSC382	19.41	2.7	-0.5	-0.6		-7.2*		8.7			-0.5
<b>CdTe</b>											
BP4405	84.13	0.1	-0.7	4.7		-2.9		-1.0			-0.1
BP4505	87.96	-1.3	-0.5	4.1		-3.4		-1.0			0.7
<b>CIS</b>											
Sie9257	40.54	-3.3	5.0	3.1		-3.1		-1.3			-3.7
Sie9260	40.10	-3.5	7.6	4.2		-4.7		-3.0			-4.1
<b>Concentrator</b>											
PTEL#1	3.015	3.3	0.8			-3.8					3.0
PTEL#2	2.913	-0.3	3.0			-7.3					4.3

\* No spectral mismatch correction applied.

# Nameplate tolerance of various major manufacturers (2010) – TYPICALLY +/- 3%!

## Manufacturer # 1

- Nameplate tolerance =  $\pm 3\%$

## Manufacturer # 2

- Nameplate tolerance =  $\pm 3\%$

## Manufacturer # 3

- Nameplate tolerance =  $\pm 3\%$

## Manufacturer # 4

- Nameplate tolerance =  $-5\%$  and  $+10\%$

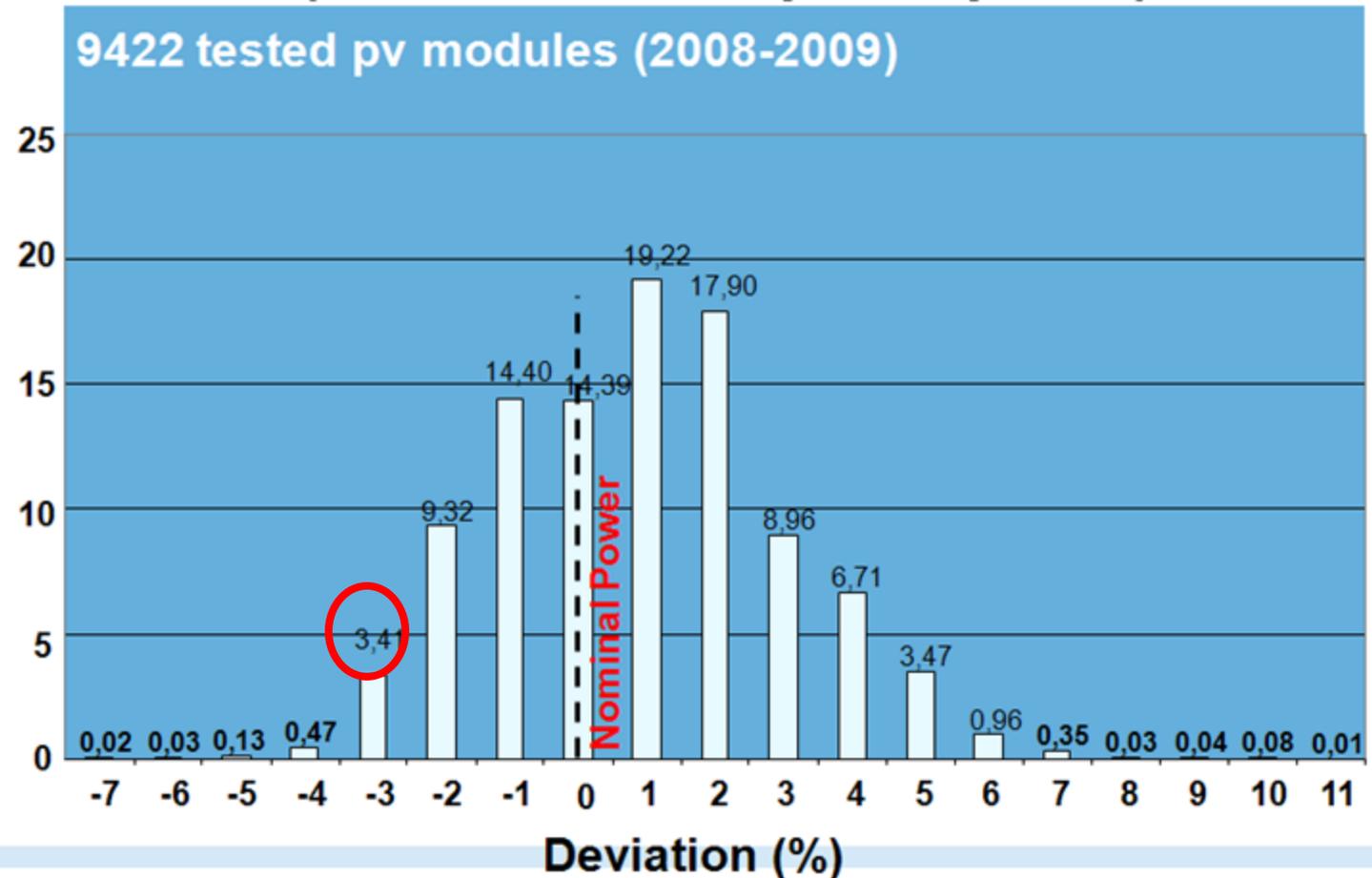
## Manufacturer # 5

- Nameplate tolerance =  $-0\%$  and  $+5\%$



More than 99% of the European power plant modules have power equal to or higher than 3% below nominal!

### Deviation of different module types (modules for PV- power plants)



# Existing Options and Their Issues for Module Power Rating Requirements

## 1) EN 50380 / IEC 61853-1:

$$(P_{\text{measured,lab}} + \underline{m}) \geq (P_{\text{rated}} - \underline{t})$$

→ Allows leniency on both sides of the equation and no limit is imposed for t.

## 2) California Energy Commission:

$$(P_{\text{rated}} - \underline{t}) \geq (P_{\text{rated}} - 5\%)$$

→ Allows higher average tolerance (5%) than needed (0%)

$$P_{\text{flash,factory}} \geq (P_{\text{rated}} - 5\%)$$

→ Allows higher flash tolerance (5%) than needed (3%)

$$(P_{\text{measured,lab}} + \underline{m}) \geq (P_{\text{rated}} - 5\%)$$

→ Allows leniency on both sides of the equation and assumes same measurement uncertainty for all the labs.

m = Laboratory measurement uncertainty  
t = Production tolerance

# Solar ABCs' DRAFT Policy Recommendation:

$$P_{\text{measured,average}} \geq P_{\text{rated}}$$

&

$$P_{\text{measured,individual}} \geq (P_{\text{rated}} - 3\% \text{ tolerance})$$



## **Solar ABCs' DRAFT Policy Recommendation:**

*“It is recommended that photovoltaic modules types sold or installed in the United States be independently measured and certified to the following power rating tolerance: after accounting for the light induced degradation<sup>1</sup> as per IEC 61215 (crystalline silicon) or IEC 61646 (thin film), the measured average<sup>2</sup> power shall be equal to or higher than the nominal nameplate power rating at STC (standard test conditions) and no individual module power shall be more than 3% below nominal. In addition, the modules shall be rated at minimum four other reference conditions as per IEC 61853-1 standard: 200 W/m<sup>2</sup> & 25°C cell temperature; 500 W/m<sup>2</sup> & 15°C cell temperature; 1000 W/m<sup>2</sup> & 75°C cell temperature; 800 W/m<sup>2</sup> & 20°C ambient temperature.”*

