

TISO 10kW: THE OLDEST GRID-CONNECTED PV SYSTEM IN EUROPE

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INTRO

Durability of PV modules represents an important concern both for module manufacturers and consumers. Regarding crystalline Si (c-Si) technology, today's photovoltaic market offers modules qualified to survive 20-30 years, with a guaranteed power production of 80% after 25 years.

In 1982, a 10kW c-Si PV plant was installed on the roof of the ISAAC (ex TISO). It has been the first grid-connected system in Europe. Through the comparison between accelerated lifetime tests and outdoor performances is shown that, despite various problems involving the modules, the modules power after 28 years is around 81% of the nominal value (i.e. in agreement with the current warranties offered by manufacturer).



PLANT FEATURES

Connection to the grid: May 13th, 1982

Nominal Power: 10.66kWp

Type of modules: ASI 16-2300, 37Wp sc-Si by Arco Solar

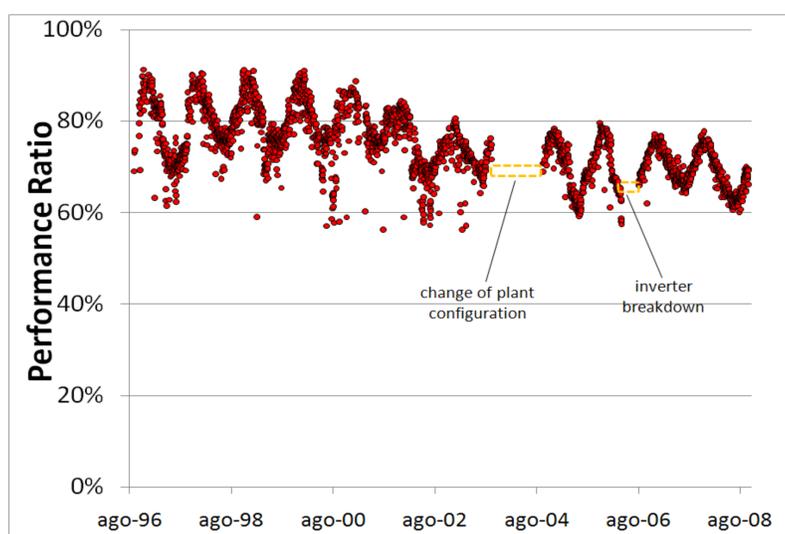
Number of modules: 288

Array tilt: 55° and 7°E

Location: Lugano, South Switzerland (46°N, 8°E)

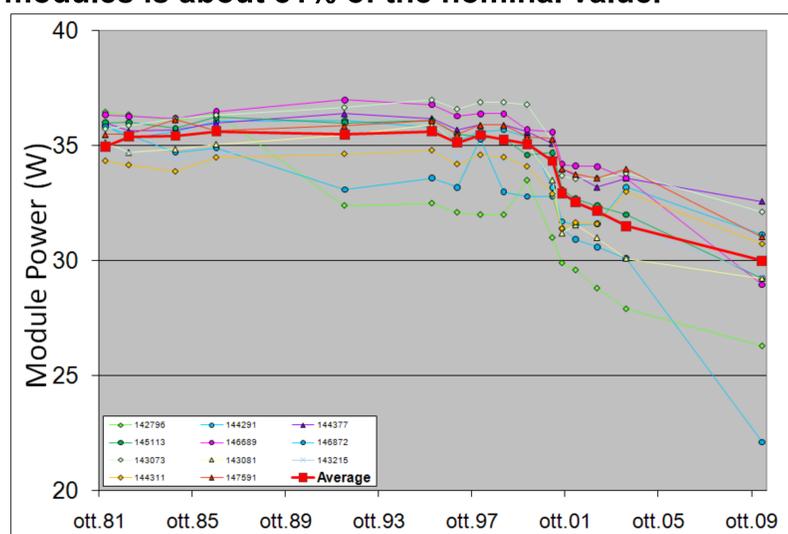
OUTDOOR PERFORMANCE

The plant worked since 1982 until 2008 when it has been dismantled from the original roof in order to be rebuilt on another roof (end 2010). After 26 years the PR value under real working conditions (not T-corrected) is around 70% of the nominal value.



INDOOR MEASUREMENTS

Since 1982, indoor measurements on a batch of 18 modules have been periodically executed. After 28 years the average power of these modules is about 81% of the nominal value.



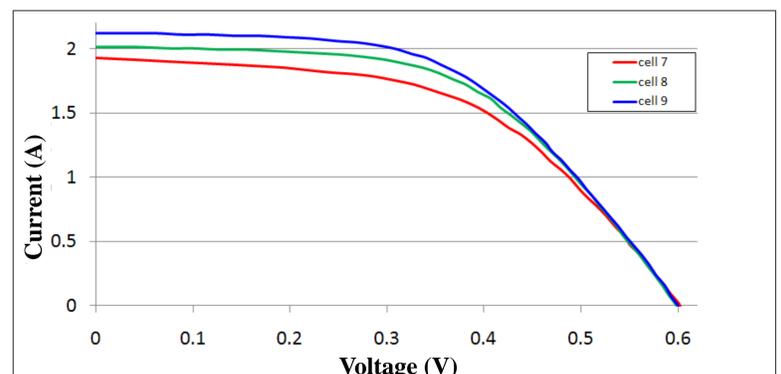
MAIN PROBLEMS AND CONSEQUENCES

Between 2001 and 2003 all the modules of the plant underwent a detailed analysis (in collaboration with the JRC) in order to determine the main problems affecting the plant after 20 working years.

Several types of defects were detected during intensive visual inspection.

Defect type	% ₂₀₀₃
• yellowing of encapsulant	98%
• browning of electrical cell grid	93%
• encapsulant delamination	92%
• terminals oxidation	45%
• broken cells	22%
• tedlar backsheet detachment	20%
• junction box detachment	n.a.
• terminals detachment	n.a.

The correlation between modules electrical characteristics and visual defects allowed to determine which of the detected physical anomalies affect modules performance as shown in the following example for the encapsulant delamination.



Cell n°	% delaminated area	ΔP (cell 7 as reference)
7	12.3%	-10.6%
8	5.6%	-3.4%
9	0	0