PV Manufacturing R&D
Inverter Manufacturing Progress

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The DOE Workshop on
Systems Driven Approach
To Inverter Research & Development

Maritime Institute, Baltimore, MD
April 23-24, 2003
New PV Manufacturing R&D Solicitation

PV Manufacturing R&D – Large-scale Module and Component Yield, Durability, and Reliability

http://www.nrel.gov/contracts/solicitations.html
Letter of Interests Due July 15, 2003
Acknowledgements

- U.S. DOE
- Ward Bower, SNL
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- Ed Witt, NREL
The U.S. DOE, working with the U.S. photovoltaic industry, initiated the PV Manufacturing R&D Project to conduct manufacturing research to accelerate PV production capacity scale-up and affect manufacturing cost reductions.
Initiated in 1990 by DOE, NREL, SNL, and US PV Industry

Total investment to date - ~$140M - $80M DOE share, $60M industry share

Six procurements to date

Current procurement – In-line Diagnostics and Intelligent Processing (IDIP)
8 subcontracts containing inverter work since 1995

$8,252k total contract values to date - ~6% of total project

$5,353k DOE Share – average of 35% cost share

One currently active
1995 – Phase 4A1

- Advanced Energy Systems – Next-Generation Three Phase Inverter
- Ascension Technologies – Manufacture of an AC Photovoltaic Module
- Omnion Power System Engineering – Three-Phase Power Conversion for Utility-Interconnected PV Applications
- Solar Design Associates – The Development of Standardized, Low-Cost AC PV Systems
- Trace Engineering – Modular Bi-Directional DC-to-AC Power Inverter Module for PV Applications
Inverter Related Subcontracts

- **1998 – Phase 5A1**
  - Ascension Technologies – *Cost Reduction and Manufacture for the SunSine 325 AC Module*
  - Omnion Power System Engineering – *Manufacturing and System Integration Improvements for One- and Two-Kilowatt Residential PV Inverters*

- **2000 – In-line Diagnostics and Intelligent Processing**
  - Xantrex – *PV Inverter Products Manufacturing and Design Improvement for Cost Reduction and Performance Enhancements*
Advanced Energy Systems

Next-Generation Three Phase Inverter – ‘95

- Goal – Simplify mfg methods for 50-100 kW inverters to reduce costs and improve reliability
- Incorporated digital control, smart power components, and soft switching
- Designed and built prototypes for grid-tied and stand-alone/hybrid inverters
- Tested at SNL and NREL/NWTC
Manufacture of an AC Photovoltaic Module – ’95
Cost Reduction and Mfg of the SunSine 325 AC Module – ‘98

- Goal – Develop an integrated, grid-tied, AC PV module. 5000/yr mfg rate
- 300 W inverter designed with grid isolation, no output until properly grid-tied, auto shutdown when grid is down
- Soft switching introduced in ‘98
- UL Listed (UL 1741)
Manufacture of an AC Photovoltaic Module
Goal – Develop a mfg process for 3-phase, 100 kW grid-tied inverter

Product to achieve MTBF of 40,000 hr

94% DC/AC conversion efficiency over 15 kW

Current THD <4%, voltage THD <2%

ISO 9001 manufacturing
Omnion Power Corporation

Three-phase Power Conversion for Utility-interconnected PV Applications – ’95
Goal – Pursue design and mfg enhancement to 1 and 2 kW residential products

- ISO 9001 manufacturing approach
- Input voltage of 100-400V, output 120V
- Transformerless topology
Goal – Design and build a micro-inverter for a 240 W PV module

Goal of $0.20-0.25 per Wp at 10,000 units per year

- UL listed
- FCC certified
Development of Modular, Bi-directional Power Inverter for PV Applications – ’95

- Goal – Develop prototype for a modular, bi-directional inverter that is highly manufacturable and compact
- Reduced size 30%, parts costs 35%, labor costs 42%
- UL listed
Goal – Use latest Digital Signal Processor technology to develop next generation products with common platforms, reduced costs, and increased performance

Work underway on PV10-208, PV20-208, and new PV2.5A

For 10 kW unit, costs ↓ 53%, housing volume ↓ 58%, conversion loss ↓ 49%, labor ↓ 47%
Xantrex 20 kW

Existing

New Design
Xantrex

10 kW

20 kW
8 subcontracts containing inverter work since 1995

Continued inclusion of component, BOS, and systems efforts in PV Manufacturing R&D efforts

Development of metrics for these programmatic categories similar to module cost/capacity

Explicit effort to ensure that future awards support inverter 5-year plan
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