U.S. Department of Energy
Energy Efficiency and Renewable Energy

DOE Solar Energy Technologies Program
Inverter R&D

Dan Ton

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

Maritime Institute, Baltimore, MD
April 23-24, 2003

PV Inverters

- **Past –Reliability/cost Issues:**
  - Different Program Focus
  - Low Volume, Customized Designs, Discrete Components
  - Inadequate Quality Control
  - Implementation Barriers
- **Present-Quality/cost Improving:**
  - New System Reliability Emphasis
  - Crosscutting Other DER Technologies
  - Quality Improving - QA Programs, HALT testing
  - Standards Reducing Barriers
- **Future Opportunities:**
  - Modular, Multi-purpose, Plug-and-play
  - All Digital Processing
  - Crosscutting Many Technologies > Economies of Scale

Recent Solar Program Inverter Activities

- **Interconnection Standards (UL1741, IEEE 929, IEEE 1547)**
- **Laboratory Testing at Sandia**
  - **Benchmark Commercial Products**
  - **Development Tests for Manufacturers**
  - **Special User-requested Tests (Utilities)**
- **Inverter Certification**
  - **Test Protocol Nearly Complete**
  - **Basis for Collaborative Long-term Testing**
- **Industry Contracts**
  - **HALT Testing (Extended MTFF by Factor of 3)**
  - **Manufacturing Quality Programs and Audits**
- **High Reliability Inverter Development Program**

High Reliability Inverter Program Objectives

- **Greater Than 10-year MTFF (2004 goal)**
- **Lower Inverter Costs**
- **Modular Design for Multiple Technologies**
  (PV, Storage, Fuel Cell, DER)
- **Flexible Design for Multiple Applications**
  (Grid-tied, Stand-alone, Hybrid, UPS)
- **Scalable - < 10 kW Initial Size**

High Reliability Inverter Program Team

- **DOE:**

  Richard King (PV), Pat Hoffman (DER), Imre Gyuk (ESS)

- **Sandia:**

  Ward Bower, Sig Gonzalez, Jerry Ginn, John Stevens

  Mark Ralph, Michael Quintana, [Russ Bonn]

- **Industry:**
  - **GE**
  - **SatCon**
  - **Xantrex**

High Reliability Program Status

- All Phases Cost-shared by Industry (50% Minimum)
- Phase I - Feasibility Study
  - Contract Awards 8/2002
    - GE, SatCon, Xantrex
  - Studies completed 12/2002
- Phase II - Finalize design
  - Contract Awards May 2003
- Phase III – Final Prototype Hardware
  - Contract Awards August 2004 Estimated

High Reliability Inverter Program Budget

- FY 02: $550K Total
  - PV-$300K
  - DER- $150K
  - Storage - $100K
- FY 03: $2 M
- FY 04: $1.5M
- FY 05: $1.5M

Future Inverter R&D

- **Adjust High Reliability Inverter Program**
  - **Workshop Consensus**
  - **Systems Driven Approach**
- **Chart Future Inverter R&D**
  - **Inputs: Workshop Outcome, Multi-Year Program Plan**
  - **Expected Outcomes:**
    - ***5-year Inverter R&D Plan***
    - **Modeling, Manufacturing, Thermal Management,…**
    - **Emphasis on Multiple Applications**
- **Involve SBIR**
  - **"Plug & Play" Modular Inverter With Automotive & Other Technology Ties**
  - **AC PV Building Block- The Integrated Inverter Design Options**

Solar Program/EERE and the Rest of DOE

- **Current Collaboration**
  - **PV, DER and Storage in the High Reliability Inverter Program**
- **Other Possible Collaborations:**
  - **Office of Transmission and Distribution Reliability**
  - **FreedomCar and Vehicle Technologies Program**
  - **Cross Cutting in Monolithic Building Blocks, Plug & Play**
  - **Technologies with Established High Volume (UPS, Motor Drives, etc.)**
- **Solar Program Looking for Opportunities to Collaborate**
  - **Develop a Core/modular Inverter Program**
  - **Push for an Economies of Scale**
  - **Consolidate and Focus Resources**
  - **Avoid "Re-invention of the Wheel"**