



U.S. DEPARTMENT OF
ENERGY

Manufacturing R&D

Pete Devlin

**2009 DOE Hydrogen Program & Vehicle
Technologies Program Annual**

Merit Review and Peer Evaluation Meeting

May 20, 2009

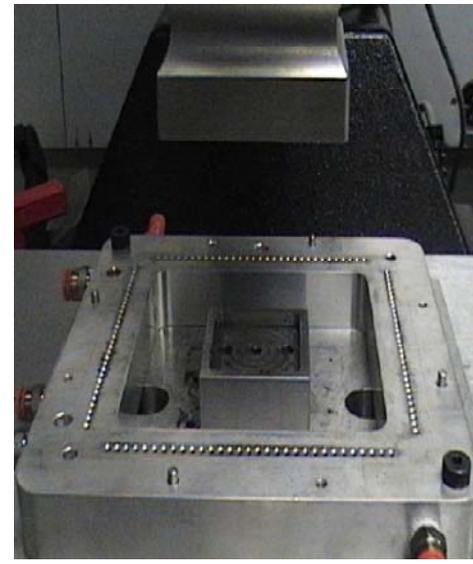


Develop and demonstrate technologies and processes that will:

- *Reduce cost of components and systems for fuel cells, storage, and hydrogen production*
- *Grow domestic supplier base*

Program Milestones

- **2010:** Complete development of standards for metrology of PEM fuel cells.
- **2012:** Develop continuous in-line measurement for MEA fabrication.
- **2013:** Establish models to predict the effect of manufacturing variations on MEA performance.
- **2013:** Demonstrate pilot scale processes for assembling stacks.



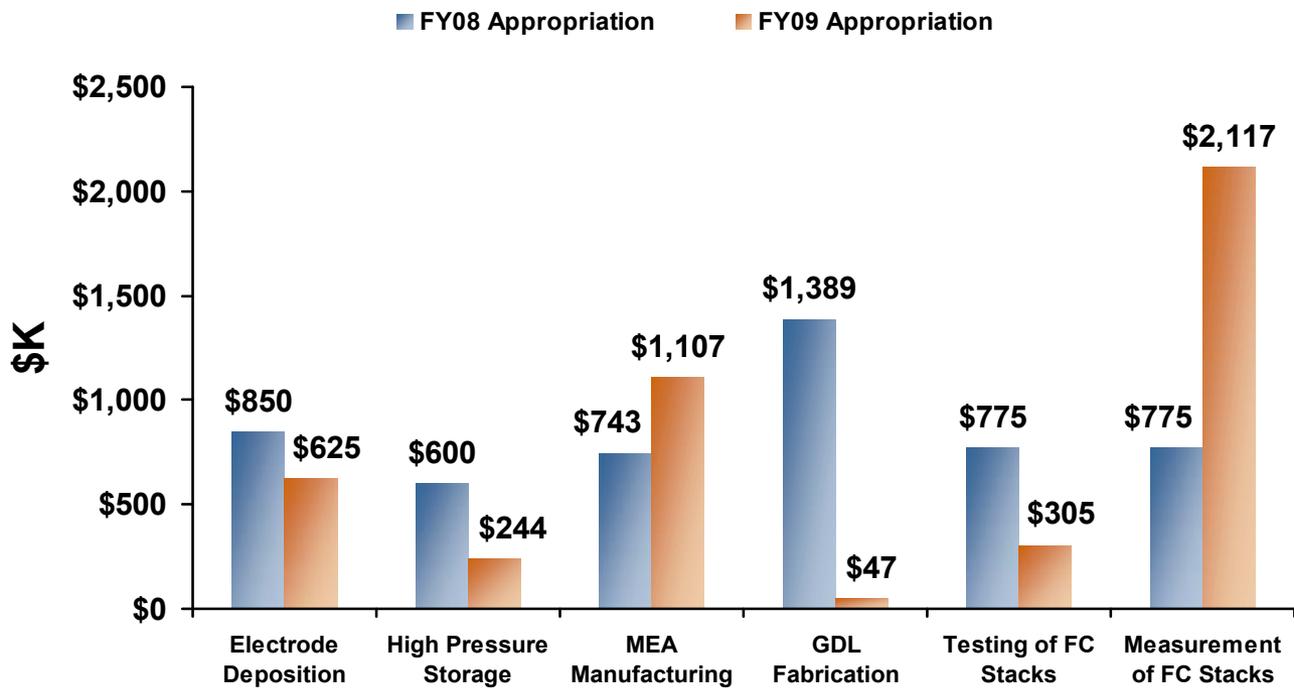
RPI's work on ultrasonic welding for MEA pressing.

Near Term Goal for Early Markets

- Lower fuel cell stack manufacturing cost by \$1,000/kW (\$3,000 to \$2,000/kW)



FY 2009 Appropriation = \$4.9M
FY 2008 Appropriation = \$4.9M*



- EMPHASIS**
1. Electrode Deposition
 - BASF, PNNL
 2. High Pressure Storage
 - Quantum Technologies
 3. MEA Manufacturing
 - Gore, LBNL, RPI
 4. Gas Diffusion Layer (GDL) Fabrication
 - Ballard
 5. Effective Testing of Fuel Cell Stacks
 - PNNL, UltraCell
 6. Effective Measurement of Fuel Cell Stacks
 - NREL, NIST

Bi-polar plate manufacturing (SBIR)

* \$678K was funded by the Fuel Cell R&D Team in FY 2008.



Critical projects are underway with initial results.

- Analyzed fuel cell stack manufacturing method procedure, throughput time, labor time, yield, failure modes (UltraCell)
 - Investigated leak-test methods and fuel cell stack components
 - Created specification for leak-testing
- Downselected on-line GDL coating weight measurement tool (Ballard)
- Validated 2D thickness measurement on different membranes, membranes with defects (NREL)
- Demonstrated ultrasonic welding (electrodes to sub-gaskets) cycle time of less than one second; current process (heated press) cycle time is one minute (RPI)
- Tested current commercial MEA (Gore)
 - Modeled generic decal lamination process
- Modeled Composite Tank Manufacturing Costs (Quantum /Boeing)
 - Alternate Processes – Filament winding (baseline), Automatic fiber placement, dry tape techniques
 - Manufacturing time and cost factors: labor, materials, equipment for specific processes

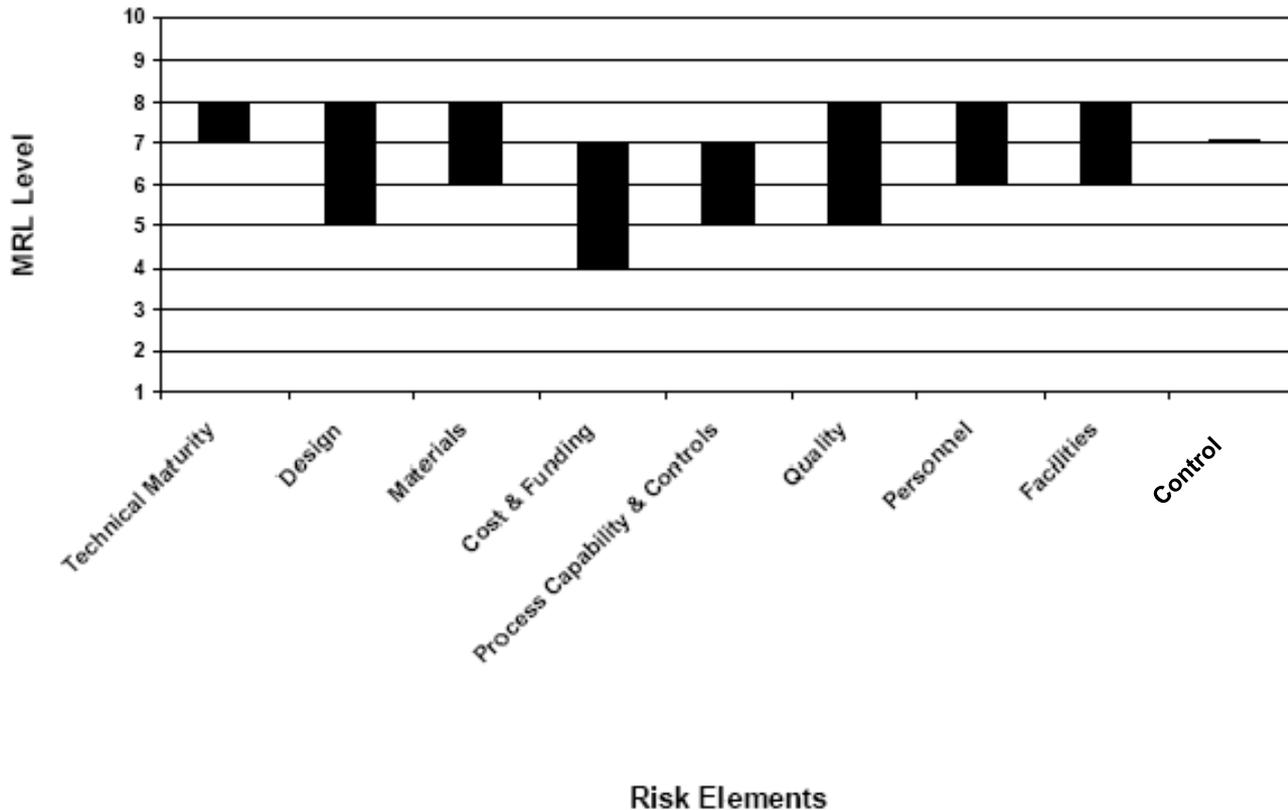


Research project assessments needed for early market applications.

Manufacturing Readiness Levels (MRLs)

- MRL - 1 Manufacturing Feasibility Assessed
- MRL - 2 Manufacturing Concepts Defined
- MRL - 3 Manufacturing Concepts Developed
- MRL - 4 Laboratory Manufacturing Process Demonstration
- MRL - 5 Manufacturing Process Development
- MRL - 6 Critical Manufacturing Process Prototyped
- MRL - 7 Prototype Manufacturing System
- MRL - 8 Manufacturing Process Maturity Demonstration
- MRL - 9 Manufacturing Processes Proven
- MRL - 10 Full Rate Production demonstrated and lean production practices in place

Manufacturing Readiness Assessment
Consolidated Data
Forklift Fuel Cell Power System Manufacture



Focus on progress toward near term cost goals for early market applications.

- Assess manufacturing readiness levels for Low Rate of Initial Production (LRIP) of 1000 units per year
- Establish Quality Assurance (QA) protocols
- Validate new processes against QA standards
- Achieve quantified near term cost targets



Ultracell modular fuel cells



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