Manufacturing R&D
DOE Fuel Cell Technologies Program
Pete Devlin

2010 Annual Merit Review and Peer Evaluation Meeting
June 7th, 2010
**Goal & Objectives**

**Goal:** Develop and demonstrate technologies and processes that will: Reduce cost of components and systems for fuel cells, storage, and hydrogen production and Grow domestic supplier base

**Program Milestones**

- **2011:** 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.

**Near Term Target for Early Markets**

- Lower fuel cell stack manufacturing cost by $2,000/kW ($4,000 to $2,000/kW)
**Fuel Cell Manufacturing Budget**

**FY 2010 Appropriations = $5.00M**  
**FY 2011 Request = $5.00M**

- **FY 2010 EMPHASIS**
  - Complete technical process designs for fuel cell stack and components and go/no-go decisions.
  - Start Phase 2 of continuing projects with and complete by EOY 2012.

### Budget Breakdown

<table>
<thead>
<tr>
<th>Department</th>
<th>FY 2010 Appropriation</th>
<th>FY 2011 Appropriation</th>
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<tbody>
<tr>
<td>Electrode Deposition</td>
<td>$0.80</td>
<td>$0.83</td>
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<tr>
<td>High Pressure Storage</td>
<td>$0.80</td>
<td>$0.80</td>
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<tr>
<td>MEA Manufacturing</td>
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<td>$1.10</td>
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<tr>
<td>GDL Fabrication</td>
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<td>$0.79</td>
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<tr>
<td>Testing of FC Stacks</td>
<td>$0.55</td>
<td>$0.34</td>
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<tr>
<td>Measurement of FC Stacks</td>
<td>$1.35</td>
<td>$1.10</td>
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• Fuel Cell MEA Measurement R&D (NREL)
  • Developed IR-based test stand for multi-function defect detections such as pinholes, shorting, and electrode thickness variations.

• High Speed, low cost fabrication of gas diffusion electrodes for MEAs (BASF)
  • Developed an innovative on-line XRF
  • Developed a predictive model for electrode variation and defect impacts on MEA performance

• Developed process model for controlling GDL coating conditions (Ballard)
  • Significant improvement in quality yields and GDL cost reduction estimated at 53% to-date.

This is the first time a scanning XRF has been used on GDEs – BASF
2010 Progress & Accomplishments

- Manufacturing of Low-Cost, Durable MEAs Engineered for Rapid Conditioning (GORE)
  - Cost model results indicate that a new 3 layer MEA process has potential to reduce MEA cost by 25%
- Developed and Tested Non-Contact sensors for Bi-Polar Plate Process control (NIST)
- Developed and Tested Leak-Test and Conditioning Stand (Ultracell)
- Adaptive process controls and ultrasonic's for high temp PEM MEA manufacturing (RPI)
  - Ultrasonic welding of HT MEA components stronger than thermal welds, with a cycle time less than 1 sec, and more than 95% energy savings.
**2010 Progress & Accomplishments**

- Evaluated manufacturing process
  - Determined high labor costs and low product yields were keeping GDL cost high
  - Initial focus was on substrate manufacturing to allow for full-width production
  - Now focused on three key areas:
    - Improve process understanding
    - Reduction of processing steps
    - Implementation of on-line measurement techniques to improve product quality and reduce process scrap

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**GDL Actuals vs DoE Target Costs ($/kw)**

- **Cost ($/kw)** vs **Calendar Year**
- **GDL Actual costs** vs **Projected cost points**

**BMP’s Annual volume of Paper based GDLs sold (equivalent kW)**

- **GDL Volume (equivalent kW)** vs **Calendar Year**
- **BMP’s Annual volume** vs **Calendar Year**

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**Ballard Cost Reduction Forecast and Realized Cost Reduction to Date**
Major Milestones & Future Solicitations

**FY 2010**
- RFI Released (4/14/10)
- Issue FOA (08/27/10)
- Applications Due (11/05/10)
- SO Selection (02/21/11)
- GO/NO GO Decisions

**FY 2011**
- Awards Made
- Complete Standards for metrology of PEM FCs

**FY 2012**
- In-Line Measurement of MEA Fab
- Models for MEA Perf.
- DEMO Pilot Scale Processes

**FY 2013**
Focus on progress toward cost goals and early market applications.

**PEM**
- Establish Quality Assurance (QA) protocols
- Validate Manufacturing Processes and Quality Control
- Achieve quantified near term polymer fuel cell cost targets
- Develop process models and initiate research for HT stationary power

**HTFC**
- Conduct Model Analysis
- Award HTFC Projects
- Reduce capital cost to competitive range with out incentives
• This is a review, not a conference.
• Presentations will begin precisely at the scheduled times.
• Talks will be **20 minutes** and **Q&A 10 minutes**.
• Reviewers have priority for questions over the general audience.
• Reviewers should be seated in front of the room for convenient access by the microphone attendants during the Q&A.
• Please mute all cell phones, BlackBerries, etc.
Reviewer Reminders

• Deadline for final review form submittal is **June 18th**.

• ORISE personnel are available on-site for assistance. A reviewer lab is set-up in room 8216 and will be open Tuesday –Thursday from 7:30 AM to 6:00 PM and Friday 7:30 AM to 3:00 PM.

• Reviewer feedback session – **Friday, at 12:30pm (after last Manufacturing R&D session)**, in this room.
For More Information

Fuel Cell Technologies Program

Manufacturing R&D Team

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