Background

- Work stopped August 2005
  - Safety issues presented during May 2005 Review
  - Hurricane Katrina aftermath
- Work resumed April 2006
- Original goals
  - Low cost of produced H$_2$ by increased pressure and increased efficiency
- Goals for 2006/07
  - Low cost of produced hydrogen by increased capacity and reduced capital/manufacturing costs
Overview

- **Timeline**
  - Project start: April 2004
  - Project end: April 2007

- **Budget**
  - Total funding: $3,128,764
    - DOE share: $1,563,882
    - TESI share: $1,563,882
  - Expenditure ‘04: $310,900
  - Expenditure ‘05: $444,800
  - Expenditure ‘06: $2,000

- **Partners**
  - None at this time due to recent changes in primary objectives

- **Barriers & Targets addressed**
  (overleaf)

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**TELEDYNE ENERGY SYSTEMS, INC.**
A Teledyne Technologies Company
Overview

Barriers & DOE Targets addressed

- Power conversion, Module, BOP:
  - Cost: $0.80/gge H2
  - Efficiency: 68%

- Compression, Storage & Dispensing:
  - Cost: $0.77/gge H2
  - Efficiency: 94%

- Electricity: Cost: $2.47/gge H2
- O&M: Cost: $0.71/gge H2

Total:
- Cost: $4.75/gge H2
- Efficiency: 64%
Objectives

- To advance water electrolysis and develop an Electrolytic Hydrogen Generator with the following features:
  - Low capital cost per unit produced hydrogen
  - Safe to use
  - Designed for Manufacture & Assembly
  - Increased H₂ Production capacity
  - Low life costs
  - Proven, reliable, affordable & durable.
Approach

- Develop and produce safe, low-cost, high efficiency alkaline water electrolysis system for hydrogen production.

**Cost-share, DOE/TES**
- Hardware cost analyses
- Detailed safety analyses
- Benchtop system fabrication & testing
- Prototype system design

**TES only**
- Fabrication of prototype unit
- Testing & Verification of prototype system
Approach

- 3 Major Components:
  - Electrolysis Module & System
  - Dryer / Purification System
  - DC Power Supply
Progress - Small Scale System

Small scale electrolysis system:

- Designed for 500 psig delivery pressure; MAWP of 1500 psig
- System easily configurable to run higher pressures
- Extensive safety analyses performed
- Operator safety, highest priority
Progress – Small Scale System

- Pressure Control Valves
- Electrical Hardware
- Controls & DAQ Computer
- Power Supply
- Delta P Transmitters
- Phase Separators
- High Pressure Electrolysis Module
2005 Reviewers Comments

- Too much time and effort being spent on Pressure Control System
  - Pressure control critical for safe and reliable system
- Use rupture disks, pressure relief valves to raise electrolysis pressure >1000 psi
  - High pressure electrolysis adds significant cost to system, thus deviating from DOE’s primary objective of low cost hydrogen
Future Work

- Close out original contract scope:
  - Test and verify operation of 500 psi prototype

- Achieve new contract objectives:
  - Complete design of a low cost, 150 psi alkaline generator, using DFMA
  - Fabricate prototype system
  - Test and verify lower cost, higher capacity 150 psi generator
Publications and Presentations


Hydrogen Safety

The most significant hydrogen hazard associated with this project is:

Potential mixing of H₂ and O₂
Hydrogen Safety

Our approach to deal with this hazard is:

- Numerical modeling, to predict, optimize sensor response
- Quality Assurance and leak-check of separators
- Monitoring product gases for cross-contamination
- Securing gas production, should mixing occur
- Design of unit to contain any pressure excursions