Solar-Hydrogen LED Sign

IPRO 301 - 12/7/01
History

• Started in the spring of 1997
• Over 100 graduate and undergraduate students
• Received attention from media and business world
  • WTTW 11, Chicago Sun Times
  • Many Sponsors
Overall Objective

• Design, assemble and demonstrate a stand-alone distributed power generation system which utilizes solar energy through PV panels, along with battery and hydrogen storage, to power a light emitting diode (LED) sign
Team Members

• Phase 1
  • Brian Kustwin ** (CHE)
  • Brian Berg (EE)
  • Nathaniel Brown (CHE)

• Advisor
  • Said Al-Hallaj

• Phase 2
  • Bridget Wilson ** (CHE)
  • Chris Bruenjes (CHE)
  • Andrinanda Halim (CHE)
  • Gwenn Heyer (ME)
  • Bernadette Lawardi (CHE)
  • Mariam Kittaneh (CHE)
  • Louis Tourtellotte (ME)
Phase 1
Background

• 2.2kW solar array is used to charge a 48 volt battery system
• Battery bank and inverter power the 12 volt LED sign
• LabView collects data automatically for the complete system
  • Voltages and currents: from PV, to battery bank and to load
  • Pyranometer reading
Results

• Charge Controller
  • PV2 Array - Solarex
    • Replaced the charge controller for
    • Determined original problem
    • Tested to see if charge controller works

• Display Sign Problems
  • Traced down to be a problem with Win EDT
  • Need old version of Win EDT
Results, cont.

- DC Power Supply
  - Two options for supplying power
    - 480V Source near IPRO site, need step-down transformer ~$4500
    - 220V Source on main floor, need piping up to the site ~$7500

- Ethernet Adapter and Camera Hub
  - Parts were damaged beyond repair
  - Received ethernet adapter
  - Still awaiting camera hub
Phase 2
Divisions of the System

- Fuel Cell
- Electrolyzer
- Photovoltaic
Pump- Required to feed process water inside system due to high pressure operation.

Rotameter- Measures the flowrate of water so that hydrogen produced can be measured coming out of system.

Valve- To control water flow rate.

One-way valve- to ensure that hydrogen produced does not go back into electrolyzer

Thermometer- Measures temperature coming out of electrolyzer.

Mass flow meter- measures flow rate?

Relief valve- Insures that hydrogen gas in storage tank does not go beyond 203 psi.

Pressure gauge- measures pressure in the storage tank.

Pressure Regulator- Regulates pressure from storage tank to fuel cell from 200 psi to 20 psi.
Tasks to Complete

• Create a list of all DAQ, GPIB, PC’s SCXI – modules chasse
• Create a list of measurements and sensors needed, including the ranges, resolutions, data collection speed, and reasons for using each sensor
• Create a list of all lines to be controlled, including the type of controllers and how to control
• Create a data collection analysis
Measuring Intervals

- **Photovoltaic**
  - Voltage 1/30 sec
  - Current 1/30 sec

- **Electrolyzer**
  - H$_2$ production rate 1/min
  - Temperature 1/30 sec
  - Pressure 1/min
  - Stack power (IV) characteristic 1/30 sec

- **Hydrogen Storage**
  - Pressure 1/min

- **PEM Fuel Cell**
  - Power (IV) characteristic 1/30 sec
  - H2 consumption rate 1/30 sec

- **NiCd Batteries**
  - Voltage 1/30 sec
  - Current 1/30 sec
Components Needed

- **Pump:** required to feed the water into the system due to high-pressure operation.
- **Rotameter:** needed to measure the water flow rate, which is used to obtain the $\text{H}_2$ production rate.
- **Pressure regulator:** to regulate the pressure from storage tank to fuel cell from 200 psi to 20 psi.
- **Relief valve:** to control water flow rates and to prevent the pressures between 2 tanks from becoming too high.
- **One-way valve:** to insure that hydrogen produced does not flow back to the electrolyzer.
Components, cont.

- Pressure gages: to measure the pressures of tank.
- Mass flow meter: to measure the mass flow rate.
- Thermometer: to measure the temperature of hydrogen coming out of the electrolyzer.
- Piping: for the transport of the substances.
- Purging line: made of stainless steel since it withstands high pressures and does not permeate hydrogen.
Problems Encountered

- Communication
- Lack of expertise
- Equipment acquisition
Conclusion

- Hybrid fuel cells can be a beneficial energy source
- Communication
- Organization
- Time management
- Teamwork
Recommendations

- Completely set up/link hybrid fuel cell and data acquisition systems
- Test electrolyzer and finalize data acquisition scheme
- Test LED sign (lighting, message output, etc.)
- Evaluate the possibility for a fully integrated DC system
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- **Other sponsors**
  - BP, BP Solar, IL-DCCA, ComEd, Alcad
Sources

- www.eren.doe.gov
- www.fuelcells.org
- www.h2fc.com
- www.hfcletter.com
- web.mit.edu/energylab
- Angelo Morson (Proton Energy Systems)
- John Speranca (Proton Energy Systems)
- Andy Staneck (Proton Energy Systems)
Any Questions?