V.A.12 Montana Palladium Research Initiative: PEMFC Field Trials*

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Subcontractors:

- Plug Power, Latham, NY
- Design 3 Engineering, Billings, MT
- Montana-Dakota Utilities, Billings, MT
- Ace Electric, Laurel, MT
- Energy Laboratories, Inc., Billings, MT

Project Start Date: January 1, 2007
Project End Date: December 31, 2007

*Congressionally directed project

Objectives

- Perform scientific research on the properties and uses of palladium in the context on the U.S. Department of Energy's (EERE), Hydrogen, Fuel Cells & Infrastructure Technologies Program, Multi-Year Research, Development and Demonstration Plan.
- Install, monitor and conduct analyses of fuel cells (8) to investigate long-term deterioration of reformer components and the associated effects on system performance.

Technical Barriers

This project addresses the following technical barriers from the Hydrogen Production section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(A) Reformer Capital Costs
(C) Operation and Maintenance (O&M)
(K) Durability

Technical Targets

This project will target new approaches to improve hydrogen separation and balance-of-plant durability. Insights gained from this project support the following DOE 2010 Technical Targets (Table 3.1.6, Technical Targets: Dense Metallic Membranes for Hydrogen Separation and Purification):

- Module Cost (including membrane material): $1,000/ft^2
- Durability: 26,280 hrs

Accomplishments

- The local electric service provider has approved interconnection.
- Engineering drawings are complete; a cursory review by Plug Power has taken place; the City of Billings, MT has issued a building permit for the site.
- Contracts are being finalized or are in place with Plug Power and various other subcontractors engaged in site preparation (see Figure 1).
- Site preparation is underway.
- The step-up transformer, a potentially long lead-time item, has been ordered. A spec sheet is enclosed (see Table 1).

Introduction

This will project will carry out a number of scientific tests over a yearlong period to better understand the breakdown of electro catalysts. Additionally, it will

FIGURE 1. Fuel Cell Installation Site

TABLE 1. Transformer Specifications

Measurements

Metering
- 64 samples per cycle
- IEC 60687 class 0.5 accuracy
- ANSI C12.20 0.5 compliant
- Four-quadrant energy and demand
- 49 real-time, true RMS electrical parameters
- Per phase voltage, current, peak current demand, watts, VARs, kWh, and more*
- Neutral current, THD, frequency, power factor, and more
- Megawatt option measures in MW and kV

Base unit

Physical configurations
- Integrated models have a built-in display and fit in an ANSI 10 cm (4") and DIN 96 cutout
- Transducer (TRAN) models have no display and can be fastened to a flat surface with a 10 cm (4") ANSI bolt pattern or mounted to a DIN rail. A Remote Display Module (RMD) can be ordered for the TRAN and mounted through an ANSI 10 cm (4") and DIN 96 cutout. A 4.3 m (14ft) cable is standard with this option.

Front panel display

Bright LED display with twelve 19 mm (3/4") high digits
- Displays all basic power parameters
- Easy setup for common configuration parameters
- Password protection on setup parameters
- Password protection for demand reset

Pulse outputs
- Optional kWh, kVARh and/or kVAh pulsing via two Form A outputs

Communications
- Optional RS-485 port with standard Modbus® RTU and ION® compatible protocol
- Baud rates from 1,200 bps to 19,200 bps

Plug-in power supplies
- 100 to 240 VAC (50 to 60 Hz) / 110 to 300 VDC
- Optional 20 to 60 DC (+/- 10%)
- Optional 480 VAC (60 Hz)

Specifications

Accuracy
- Voltage: L-N 0.3% reading, L-L 0.5% reading
- Frequency: +/- 0.1 Hz
- Current:
  - >= 5% of full scale: 0.3% reading
  - < 5% of full scale: 0.3% reading + 0.05% full scale
  - I4 derivation: 0.6% reading + 0.05% full scale
- Power factor: 1.0% reading
- Total harmonic distortion (THD): +/-1.0%
- Power and energy measurements:
  - (kW, kVA, kVAR, kWh, kVAh, kVARh). Complies with IEC 60687 Class 0.5 and ANSI 12.20 Class 0.5 (0.5% reading)

Environmental conditions
- Operating temp: -20° C to 70° C (-4° F to 158° F)
- Storage: -40° C to 85° C (-40° F to 185° F)
- Humidity: 5% to 95% non-condensing

Installation and input ratings
- 64 samples per cycle true RMS
- Autoranging voltage inputs allow direct connection to 400/690 VAC systems (the meter is calibrated for 60 to 400 VAC L-N connections)
- Supports Direct 4-Wire Wye, 3-Wire Wye, 3-Wire Delta, Direct Delta and single phase configurations
- 3-phase voltage and current inputs
- Impedance: 2 M Ohm/phase
- Burden: 0.05 VA (typical) @ 5 A RMS
- 5 A nominal / 10 A full scale / 20% overrange full accuracy
- Current overload rating 120 A for 1 second
- Standard terminal strip covers

Dimensions and shipping
- Basic unit installed depth: 106.7 x 106.7 x 40.6 mm (4.2" x 4.2" x 1.6")
- Remote display: 106.7 x 106.7 x 22.9 mm (4.2" x 4.2 "x 0.9")
- Shipping weight: 0.68 kg (1.5 lb)

Software
- Download free ION® Setup configuration software from our web site
- Integrate the ION6200 into PowerLogic® ION Enterprise®, our monitoring, analysis and control software

measure the durability of a reengineered fuel cell that is comprised of the most contemporary components available in the marketplace (see Figure 2).

Approach

The approach is to assemble a team of professionals that possess the resume and credentials to perform the necessary services now and going forward. Quality site prep and materials will allow the team to focus on the fuel cells in the best operating environment.

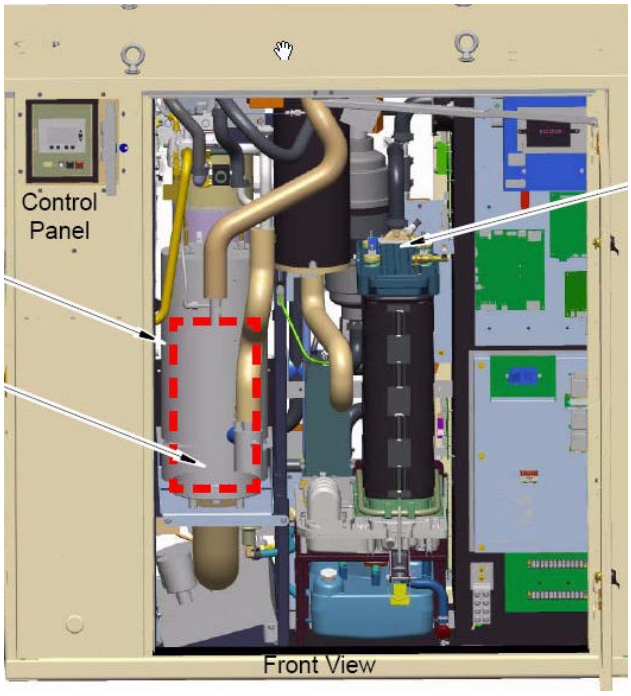

FIGURE 2. Plug Power 5kW Fuel Cell

Results

The results will advance the state of knowledge for the DOE and the fuel cell industry. We hope to establish new benchmarks in electro catalytic performance and system durability.

Conclusions and Future Directions

- Complete site preparation
- Complete training of technicians
- Take delivery and assemble fuel cells
- Install and commission fuel cells
- Provide scientific testing and O&M for 1 year
- Decommission and publish results