

Accelerating Acceptance of Fuel Cell Backup Power Systems



Project ID: H2RA007
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Project Overview

■ Timeline

- Start: August 31, 2009
- Finish: August 31, 2011
- 35% complete

■ Budget

- DOE: \$2.7 MM
- Cost-share: \$2.7 MM

■ Barriers

- Cost
- Affordability
- System reliability
- Market volume

■ DOD Partners

- Warner Robins AFB
- Ft. Irwin, CA
- Construction Engineering Research Laboratory (CERL)

Approach

GenCore

Backup Power

- Hydrogen fueled
- Start time < 1 minute
- Run time = 4 hours

GenSys

Extended Backup Power

- Hydrogen and LPG fueled
- Start time < 1 minute
- Run time = indefinite

GenSys

Continuous Power

- LPG fueled
- Start time = 3 hours
- Run time = indefinite



Approach









- **Cost Analysis and Commercialization Study** **Complete**
- **Site Planning and Applications Engineering** **50% complete**
- **Site Specific Engineering Development** **20% complete**
- **Systems Builds and Factory Testing** **95% complete**

Go/No Go: After 20 simulated extended run power outage profiles, the system must be able to produce 6kW of DC power at a combined efficiency of >24% using propane available at Plug Power's Latham facility

- **Fleet Operation and Managed Services** **0% complete**
- **Project Closeout** **0% complete**
- **Program Management** **35% complete**

Cost Analysis

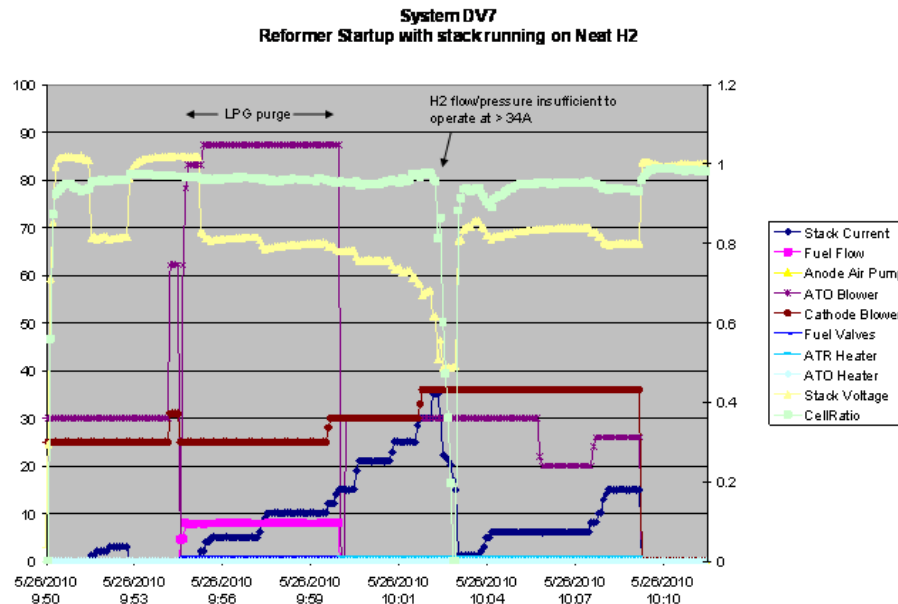
- The GenSys LT offers economic as well as environmental benefits over the incumbent diesel generator technology
- Near threefold advantage in system life with only 20-25% higher maintenance costs than a diesel generator
- The GenSys LT offers the customer a 20 to 30% decrease in power generation expense

Telecom Cell Tower Application Comparison (4.5 kW Case)		
GenSys System	Features	Diesel Generator
43,800 Hours (5 Years)	System Life 	15,000 Hours (1.71 Years)
System, Inverter, Batteries 2.4% less	5-Year Capital Costs 	3 Generators, AMF Panel, PIU, SMPS, Batteries 2.4% more
Range: 20% to 32% 4.5 kW Point: 29.1% (BOL)	Efficiency $\frac{P_{out}}{P_{in}}$	Range: 7% to 21% 4.5 kW Point: 18.5% (BOL)
LPG, potential to run on a range of hydrocarbons	Fuel Type 	Diesel
75-85% less fuel expense than diesel generator	5-Year Fuel Costs 	75-85% more fuel expense than fuel cell
Comparable maintenance 20-25% more than DG	5-Year Maintenance Costs 	Comparable maintenance 20-25% less than FC
>99%	Reliability / Availability 	>99%
7.0 metric tons of C, 0.4 g of NO _x , 0.06 g of SO _x , 0.51 g of CO annually	Emissions to Environment 	14.4 metric tons of C, 743 g of NO _x , 49 g of SO _x , 160 g of CO annually
65 dBA at 3 m	Noise Level 	75 dBA sheltered 92 dBA unsheltered

BOL= Beginning of Life

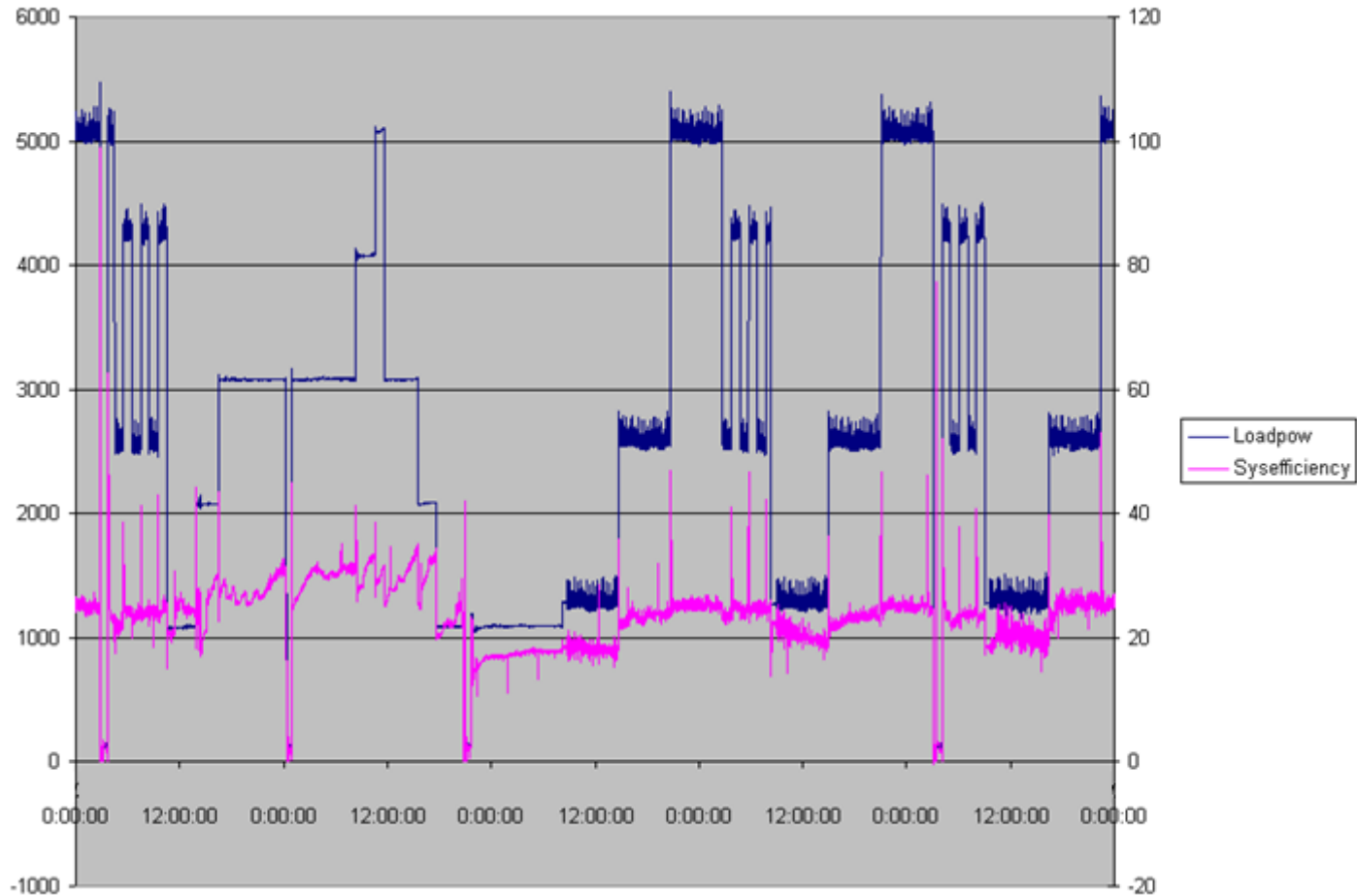
Technical Accomplishments – Hydrogen Startup

- An economically viable path to 72 hours worth of backup power with a pure hydrogen solution was not determined
- Focus shifted to backup power/grid assurance with LPG



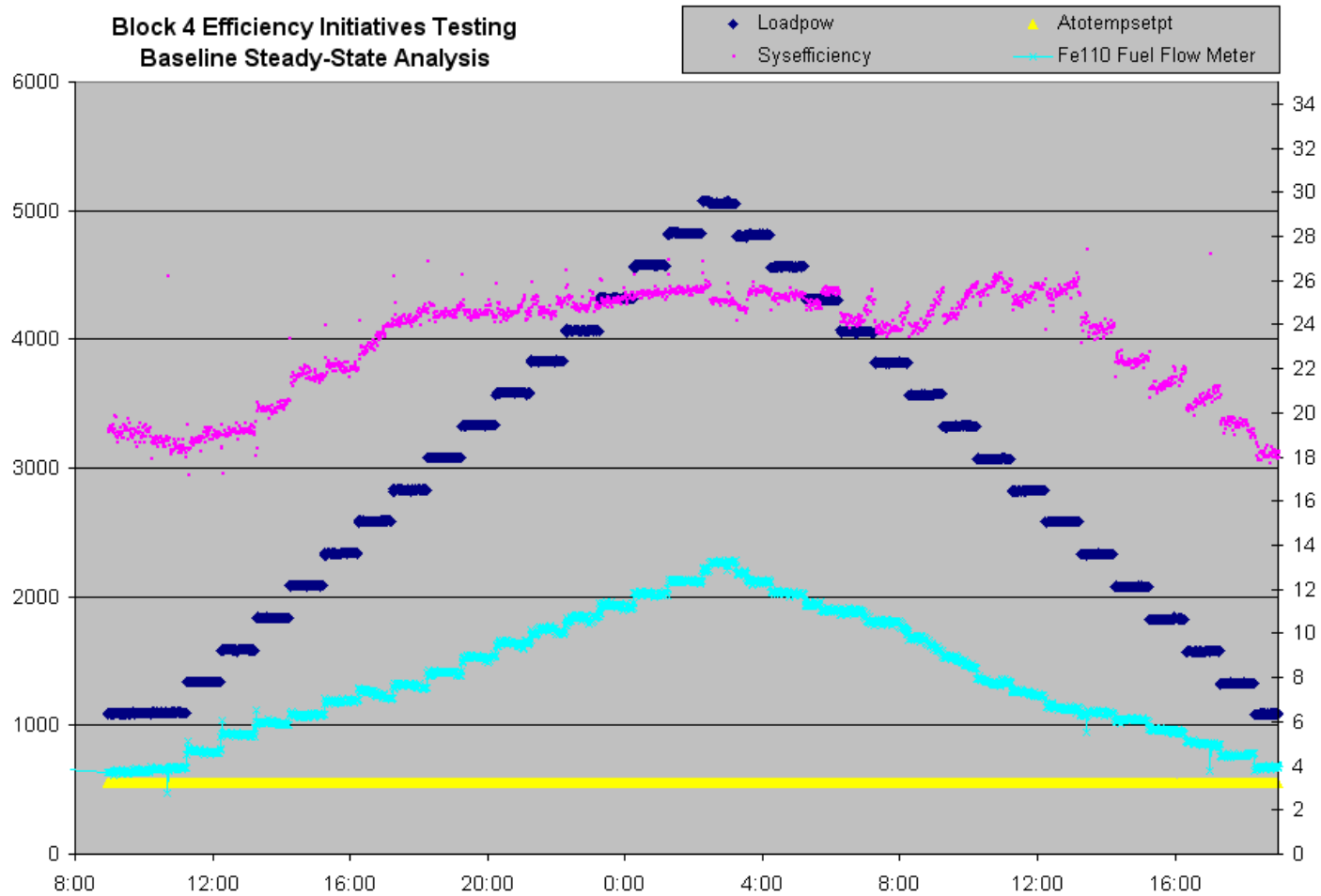
Hydrogen startup demonstrated in the lab

Technical Accomplishments – System Operation



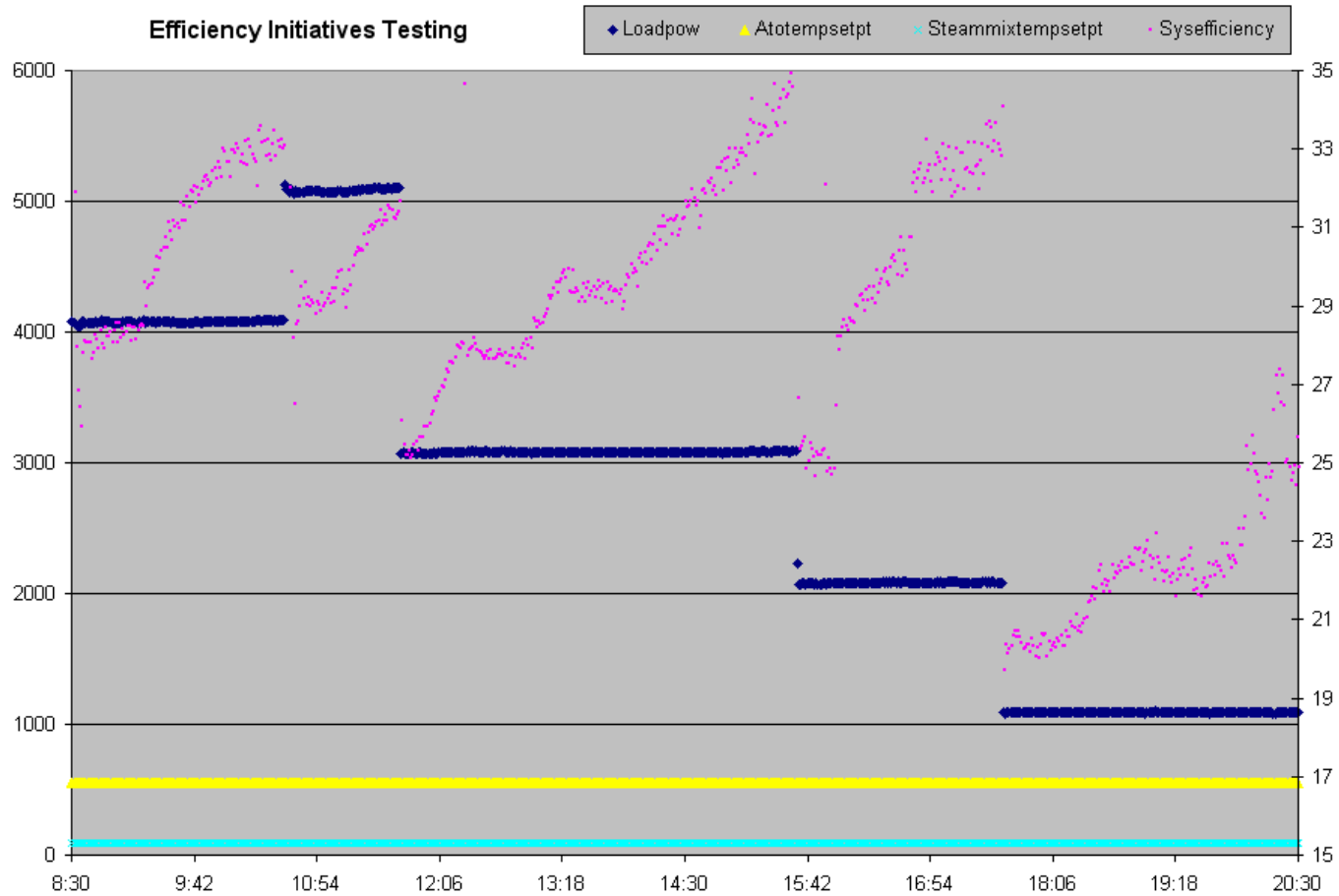
> 25% average electrical efficiency over a wide range of operation

Technical Accomplishments – Efficiency Improvements



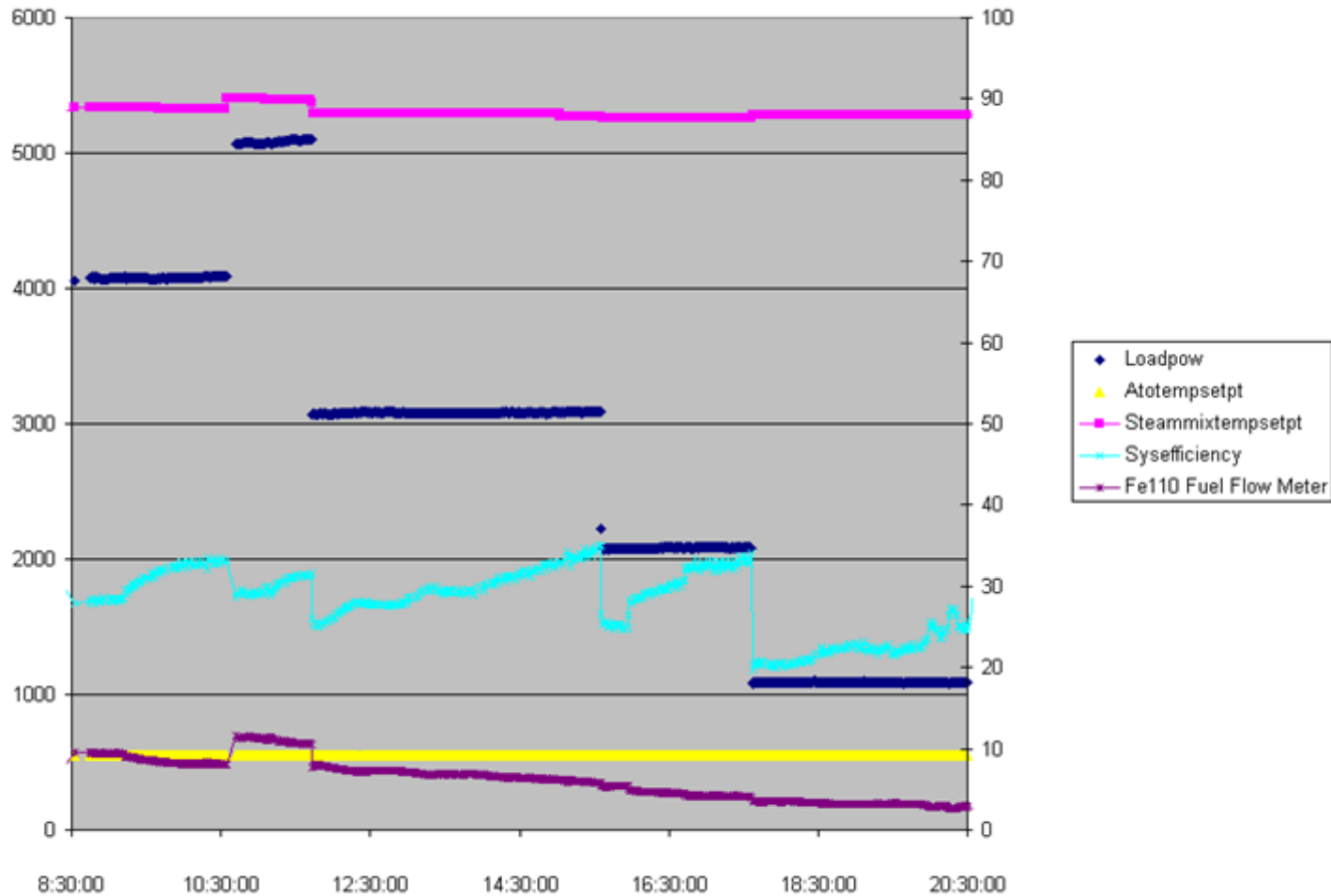
Baseline test showing efficiency vs. power levels

Technical Accomplishments – Efficiency Improvements



Effect of lowering steam mixing temp on efficiency

Technical Accomplishments – Efficiency Improvements



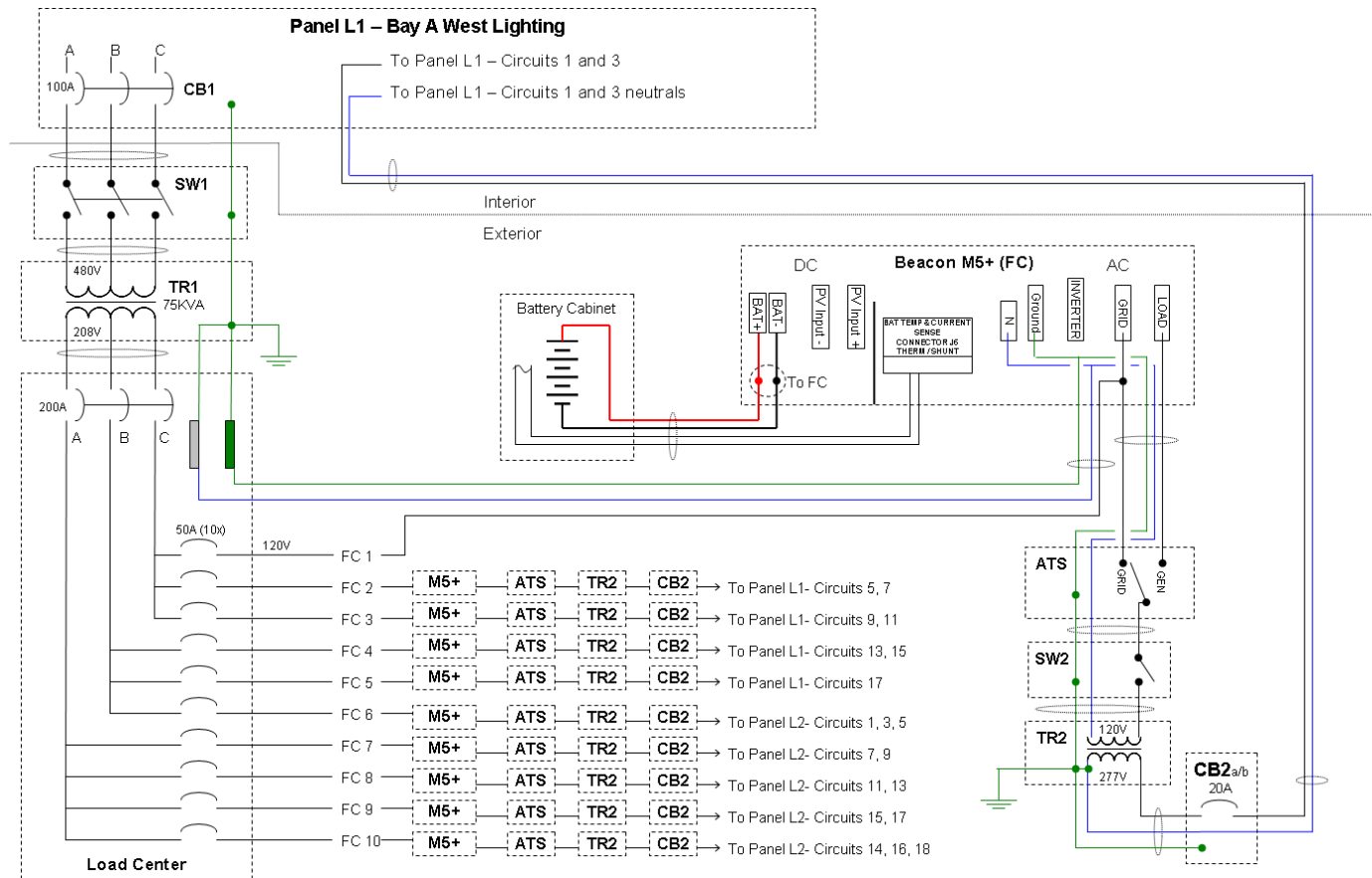
Optimization of operational parameters brings efficiency over 35%

Technical Accomplishments - Site Selection



- The team visited the Defense Distribution Depot - Warner Robins AFB (DDWG), Georgia for detailed site analysis for installation of Fleet 1
- Ten GenSys LT systems will back up the lighting at the Air Logistics Center at Warner Robins

Technical Accomplishments - Site Selection



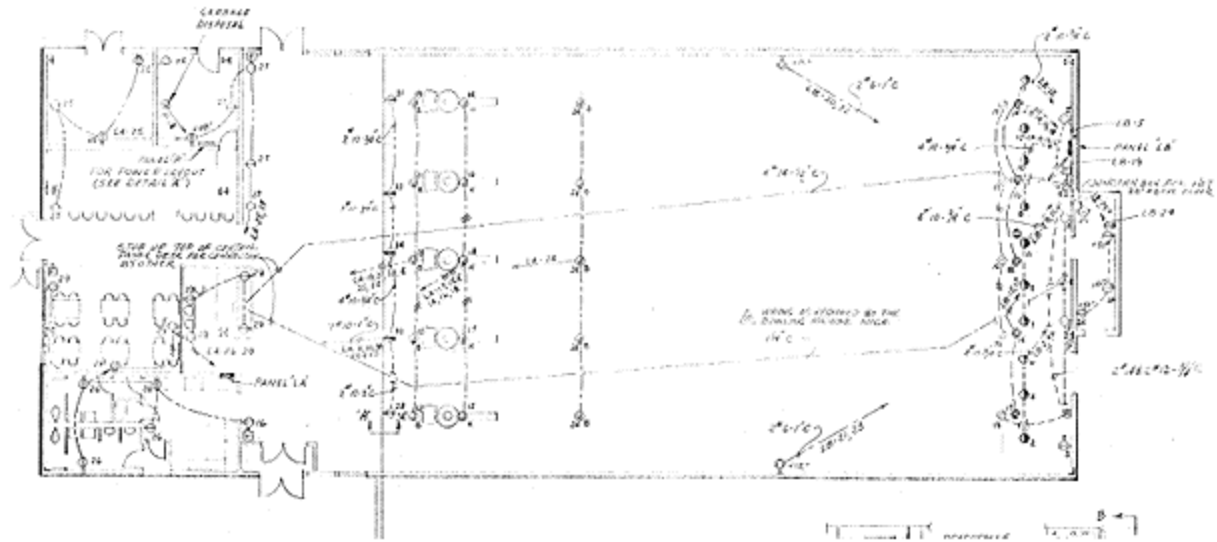
The team is working with the base to develop the site design

Technical Accomplishments - Site Selection Ft Irwin



- The team visited Ft Irwin, CA 1Q11 for site analysis of Fleet 2 installation
- Ten GenSys LT systems will back up the lighting at the Strike Zone Center at Ft Irwin

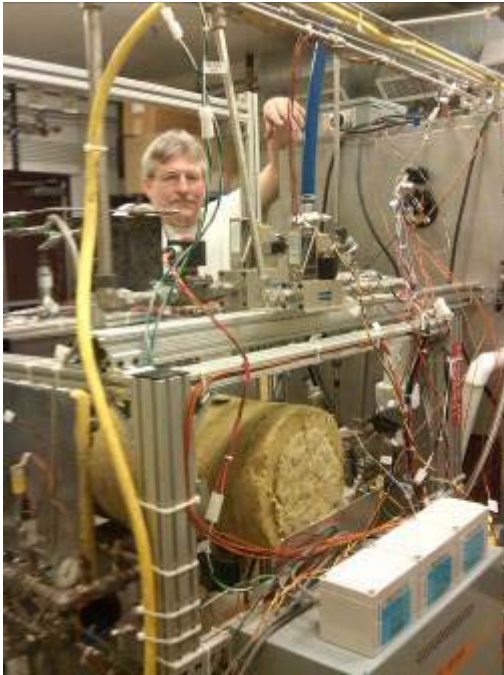
Technical Accomplishments - Site Configuration



Power plan of building

The team is developing the site inverter interconnect design

Technical Accomplishments - System Build



Reformer Qualification Testing



Stack Qualification Testing



GenSys LT systems prepped for shipment to sites spare parts allocated.

Systems for the program are built, tested and being prepped for shipment

Technical Accomplishments - System Installation & Field Tests

- Developed interface plan between GenSys converter and local grid on both bases.
- Installed trial grid topology at Plug Power and performed simulated power outages to confirm proposed interconnect strategy.
- Early results show promise, still working with systems controls and battery buffers to improve reliability.



Translate Field Tests to FT Irwin and WRAB

Future Work

- ✓ Select sites for Fleet 2 at FT Irwin, CA 1Q11
- Perform site engineering work at FT Irwin and WRAB 2Q11
- Install and commission Fleet 1 at WRAFB 2Q11
- Install and commission Fleet 2 at FT Irwin 3Q11



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