



W9132T-05-R-0028

LOGANEnergy Corp.

Alcorn State University ROTC
PEM Demonstration Project
Initial Project Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY04

Alcorn State University ROTC, Lorman, MS

20 December 2005

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Executive Summary

Under terms of its FY'04 DOD PEM Demonstration Contract with the Engineer Research and Development Center/Construction Engineering Research Laboratory (ERDC/CERL), LOGANEnergy will install and operate a Plug Power GenSys 5kWe Combined Heat and Power fuel cell power plant at Alcorn State University in Lorman, MS. The site selected for the one-year demonstration project is the Alcorn Army ROTC Building. The unit will be electrically configured to provide grid parallel/grid independent service to the building and it will also be thermally integrated with a Munters HC300 desiccant dehumidifier to provide fresh dry air to the classroom spaces. Local electrical and mechanical contractors may be hired to provide services as needed to support the installation tasks. Using Natural Gas as the source fuel, it is anticipated that the project will add \$172.85 in annual energy costs to Alcorn during the period of performance.

The Alcorn State University POC for this project is

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The Department of Defense POC for this project is:

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

LOGANEnergy Corp. Small Scale PEM 2004 Demonstration Project at Hill AFB, UT

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 Carbonate, Phosphoric Acid Fuel Cell (PAFC) and Proton Exchange Membrane (PEM) fuel cell projects at 21 locations in 12 states, and has agreements to install 15 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP gas unit, and the GenCor 5kW hydrogen fueled standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Vinny Cassala is the Plug Power point of contact for this project. His phone number is (518) 782-7700 ex 1228, and his email address is vincent_cassala@plugpower.com.

4.0 Principal Investigator(s)

Name	Chris Davis	Keith Spitznagel
Title	Chief Operating Officer	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388	860.210.8050
Fax	770.650.7317	770.650.7317
Email	cdavis@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Chris Davis	Keith Spitznagel
Title	Chief Operating Officer	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388	860.210.8050
Fax	770.650.7317	770.650.7317
Email	cdavis@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

- a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Four-year PC25 PM Services Maintenance Agreement.

In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability.

- b) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement on 600kW UTC PC25 power block.
Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partner LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

- c) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxent River, MD.

Plug Power
Mr. Vincent Cassala
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

7.0 Host Facility Information



Figure 1: Alcorn State University Entrance

Alcorn State University was founded on the site originally occupied by Oakland College, a school for whites established by the Presbyterian Church.

Oakland College closed its doors at the beginning of the Civil War so that its students could answer the call to arms. Upon failing to reopen at the end of the war, the property was sold to the state of Mississippi and renamed Alcorn University in honor of James L. Alcorn in 1871, then governor of the state of Mississippi.

Hiram R. Revels resigned his seat in the United States Senate to become Alcorn's first president. The state legislature provided \$50,000 in cash for ten successive years for the establishment and overall operations of the college. The state also granted Alcorn three-fifths of the proceeds earned from the sale of thirty thousand acres of land scrip for agricultural colleges. The land was sold for \$188,928 with Alcorn receiving a share of \$113,400. This money was to be used solely for the agricultural and mechanical components of the college. From its beginning, Alcorn State University was a land-grant college.

In 1878, the name Alcorn University was changed to Alcorn Agricultural and Mechanical College. The university's original 225 acres of land have grown to become a 1,700 acre campus. The goals for the college set by the Mississippi legislature clearly emphasized training rather than education. The school, like other black schools during these years, was less a college than a trade school.

At first the school was exclusively for black males but in 1895 women were admitted. Today, women outnumber men at the university eighteen hundred to twelve hundred.

In 1974 Alcorn Agricultural and Mechanical College became Alcorn State University. Governor William L. Waller signed House Bill 298 granting university status to Alcorn and the other state supported colleges. In truth, this law created a change of name rather than of purpose. Alcorn had already become a more diversified university. It provides an undergraduate education that enables students to continue their work in graduate and professional schools, engage in teaching, and enter other professions. It also provides graduate education to equip students for further training in specialized fields while they contribute to the advancement of knowledge through scholarly research and inquiry.

Alcorn began with eight faculty members in 1871. Today there are more than five hundred members of the faculty and staff. The student body has grown from 179 mostly local male students to more than 3,000 students from all over the world.

While early graduates of Alcorn had limited horizons, more recent alumni are successful doctors, lawyers, dentists, teachers, principals, administrators, managers, and entrepreneurs. Alcorn has had fifteen presidents with Dr. Clinton Bristow, Jr. becoming the sixteenth president in 1995. Of these, Dr. Walter Washington, who assumed the presidency in 1969, was the longest-tenured president in Alcorn's history.

Over the decades the college that once was a struggling institution has become one of the leading black universities in the nation. Alcorn State is now fully accredited with seven schools and degree programs in more than fifty areas including a nursing program. The facilities have increased from three historic buildings to approximately 80 modern structures with an approximate value of \$71 million.

Alcorn will continue to serve the generations to come. Its distinct heritage will never be lost. Throughout the university's history, Alcorn has followed a carefully structured plan to retain and enhance the image and potential of students and to attract young people whose intent is to receive a quality education. Alcorn has served the state of Mississippi, the nation, and the world for over one hundred and twenty-five years.

8.0 Fuel Cell Site Information

The illustration in Figure 2 below depicts the Alcorn State University campus map. The black arrow points to the location of the Military Sciences Facility where the unit will be deployed.

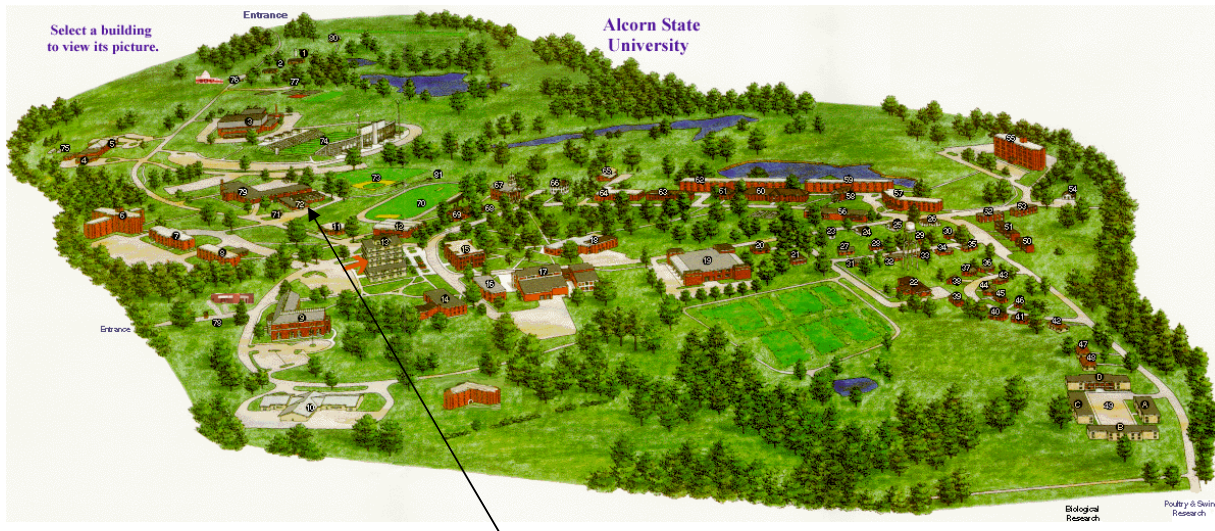


Figure 2: Alcorn State University Campus Map



Figure 4: Rear Entrance Alcorn ROTC Military Science Facility



Figure 4: Front Entrance Alcorn ROTC Military Science Facility

The photos in Figures 3, and 4 indicate the front and rear elevations of the Alcorn ROTC Military Sciences Facility. The gentleman in Figure 3 is standing in the approximate location of the future fuel cell pad site. This building houses offices, classrooms, and drill spaces for the Department of Military Science. Army ROTC is designed to increase the opportunities for college students by giving them options and potential for either a civilian or military career. The objective of the program is to develop selected college-educated men and women for positions of responsibility as officers in the United States Army, the Army National Guard, and the United States Army Reserves. This is LOGAN's third PEM project to select a university ROTC program to act as the DOD host site and the second to be associated with a historical black university.

One Plug Power 5 kW Gen Sys fuel cell system will be located at this site. All site permitting requirements will be coordinated by the University.

9.0 Electrical System

The Plug Power GenSys 5C PEM fuel cell power plant provides both grid parallel and grid independent operating configurations for site power management. This capability is an important milestone in the development of the Gensys5 product commercialization schedule. The unit has a power output of 110/120 VAC at 60 Hz, and when necessary the voltage can be adjusted to 208vac or 220vac depending upon actual site conditions. The photo in Figure 5 at right shows the service panel in the electrical closet where the fuel cell will be electrically coupled to the campus utility grid. On



Figure 5: Alcorn State University Electrical Service Panel

the wall adjacent to the service panel, LOGAN will attach a new emergency service panel to support dedicated fuel cell loads after consulting with the DOD POC to select the appropriate circuits to transfer to it. The Electric Utility provider at this project site is the Central Mississippi Cooperative.

10.0 Thermal Recovery System

While operating at a set point of 2.5 kW, the GenSys5C has a heat rate 35,200Btu/H and offloads approximately 7,800Btu/H to the customer heat exchanger. In an ongoing attempt to develop a total fuel cell energy solution that optimizes this waste heat opportunity, LOGAN intends to employ a Munters Corp. H300 Cargocaire desiccant dehumidifier at this site. As Alcorn is located in the southern US where high humidity increases air-conditioning loads, adds to utility costs, and raises other indoor environmental concerns, LOGAN believes desiccant air-conditioning may be the best use of low quality waste heat from the fuel cell to combat these issues. Munters manufactures various sized systems utilizing state-of-the-art desiccant technology with dependability and long operating life for humidity control at virtually any temperature. The HC 300 unit selected for this project has the following advantages:

- Efficient humidity control for applications including product drying, mold and mildew control, corrosion protection, storage and condensation control.
- Durable unitized body with welded aluminum construction.
- Easy access panel for inspection and maintenance. Simple ductwork connections.
- Compact, low profile design.
- Flow rates of 150-300 scfm
- Nominal moisture removal; 9.1 lbs/hr at 75F, 50% RH at 300 scfm. Capable of processing saturated, conditioned or outside air.

Figure 6 below depicts a Munters H300 unit recently installed at the Camp Mabry PEM demonstration site in Austin, TX. LOGAN intends to install a similar application at the Alcorn site.



Figure 6: Munters H300 System

11.0 Data Acquisition System

LOGAN proposes to install a Connected Energy Corporation web based SCADA system that provides high-speed access to real time monitoring of the power plant. The schematic drawing seen in Figure 7 below describes the architecture of the CEC hardware that will support the project. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, notification, and reporting functions. The system will pick up and display a number of fuel cell operating parameters on functional display screens including kWh, cell stack voltage, and water management, as well as external instrumentation inputs including Btus, fuel flow, and thermal loop temperatures. CEC's Operations Control Center in Rochester, New York maintains connectivity by means of a Virtual Private Network that will link the fuel cell to the center. LOGAN will provide high-speed Internet access to the fuel cell router through the campus Ethernet. The university will provide local dial tone to support analog communications with the fuel cell modem.

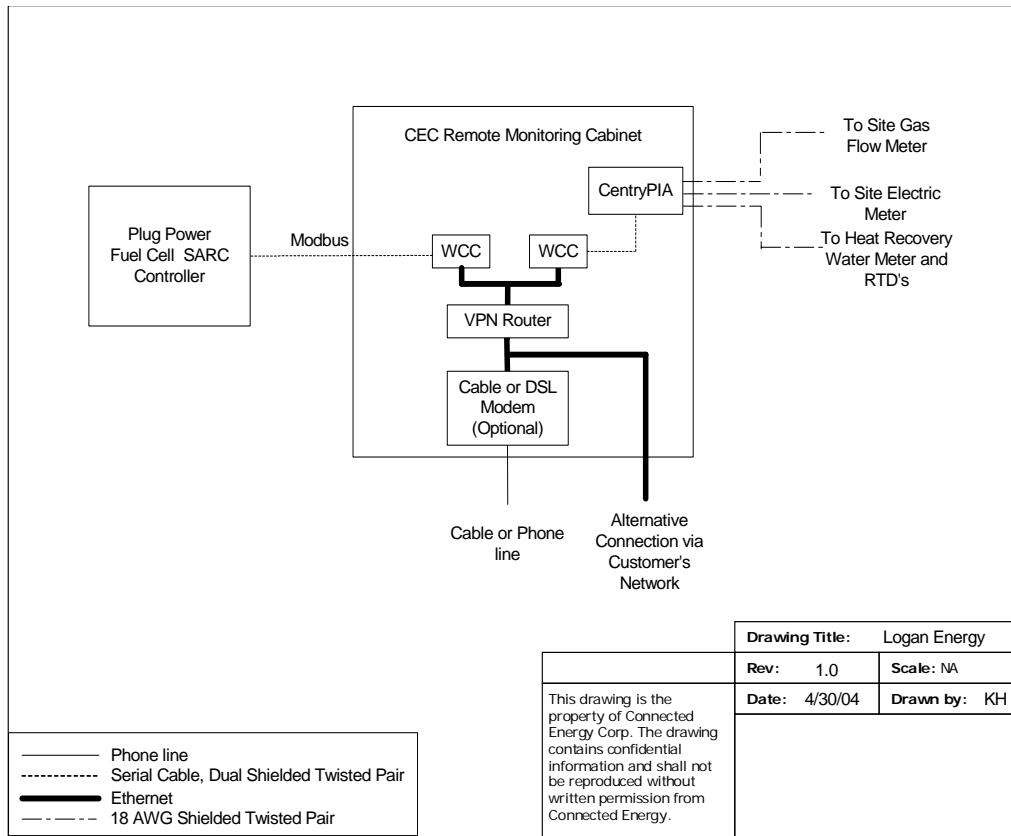


Figure 7: Fuel Cell Remote Monitoring Diagram

12.0 Economic Analysis

Alcorn State University Military Science Facility PEM Demonstration Project

Project Utility Rates			
1) Water (per 1,000 gallons)		\$	0.95
2) Utility (per KWH)			0.0473
3) Natural Gas (per MCF)		\$	8.29
First Cost		Estimated	Actual
Plug Power 5 kW SU-1		\$	65,000.00
Shipping		\$	2,800.00
Installation electrical		\$	4,225.00
Installation mechanical & thermal		\$	9,510.00
Watt Meter, Instrumentation, Web Package		\$	12,500.00
Site Prep, labor materials		\$	2,000.00
Technical Supervision/Start-up		\$	2,500.00
Total		\$	98,535.00
Assume Five Year Simple Payback		\$	19,707.00
Forecast Operating Expenses			
	Volume	\$/Hr	\$/ Yr
Natural Gas Mcf/ hr @ 2.5kW	0.0330	\$ 0.27	\$ 2,156.83
Water Gallons per Year	14,016		\$ 13.30
Total Annual Operating Cost			\$ 2,170.13
Economic Summary			
Forecast Annual kWH			19710
Annual Cost of Operating Power Plant		\$	0.110 kWH
Credit Annual Thermal Recovery Rate			<u>(\$0.054) kWH</u>
Project Net Operating Cost		\$	0.056 kWH
Displaced Utility cost		\$	0.047 kWH
Energy Savings (Cost)			<u>(\$0.009) kWH</u>
Annual Energy Savings (Cost)			<u>(\$172.85)</u>

13.0 Kickoff Meeting Information

The project kick-off meeting is tentatively scheduled to occur on January 11 at 10:00 AM CST by teleconference. At that time CERL, LOGAN and Alcorn representatives will conference to discuss the purpose, scope, and conduct of the PEM demonstration project. Prior to the conference an agenda will be circulated to all parties outlining the specific items that will be covered in the teleconference.

14.0 Status/Timeline

The timeline is included in the Appendix Section 4.

15.0 Appendix

Section 1: Sample form used to qualify the fuel cell for initial start and the project acceptance test.

Installation/Acceptance Test Report

Site: Alcorn State Univ Military Science Bldg

Installation Check List

TASK	Initials	DATE	TIME (hrs)
Batteries Installed			
Stack Installed			
Stack Coolant Installed			
Air Purged from Stack Coolant			
Radiator Coolant Installed			
Air Purged from Radiator Coolant			
J3 Cable Installed			
J3 Cable Wiring Tested			
Inverter Power Cable Installed			
Inverter Power Polarity Correct			
RS 232 /Modem Cable Installed			
DI Solenoid Cable Installed with Diode			
Natural Gas Pipe Installed			
DI Water / Heat Trace Installed			
Drain Tubing Installed			

Commissioning Check List and Acceptance Test

TASK	Initials	DATE	TIME (hrs)
Controls Powered Up and Communication OK			
SARC Name Correct			
Start-Up Initiated			
Coolant Leak Checked			
Flammable Gas Leak Checked			
Data Logging to Central Computer			
System Run for 8 Hours with No Failures			

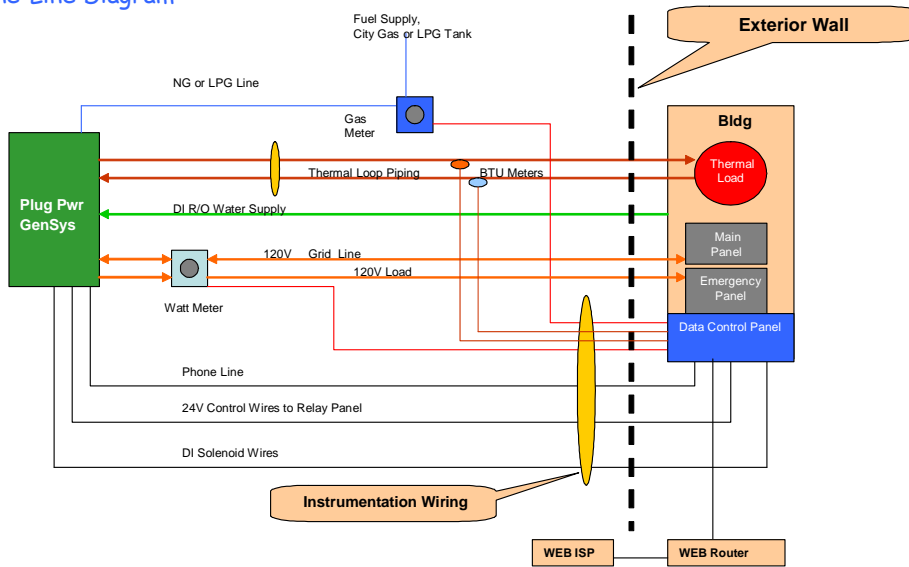
Section 2: Plug Power GenSys5C Specifications

- Dimensions 84 1/2" x 32" x 68 1/4"
- Performance Continuous Power Rating 5kW_e (9kW_{th})
- Power Output 2.5-5kW_e (3-9kW_{th})
- Voltage 120/240 VAC @ 60Hz
- Power Quality IEEE 519, Grid Interconnect IEEE P1547
- Emissions NO_x <1ppm...SO_x <1ppm
- Noise <60 dBA @ 1 meter
- Operating Conditions Temperature 0°F to 104°F
- Elevation 0 to 6000 feet
- Installation Outdoor
- Electrical Connection, Grid Parallel/Grid Independent
- Fuel, Natural Gas
- Certifications Power Generation, CSA International
- Power Conditioning UL 1741— Electromagnetic Compliance FCC Class B —



Section 3: Installation Line diagram

GenSys Typical Installation
One-Line Diagram



Section 4: Alcorn State University Timeline

Alcorn State University PEM Fuel Cell Demonstration Project

Installation, Monitoring, Performance Evaluations, & Reporting on One Plug Power PEM Fuel Cell At MILITARY Science Bldg

Column Headings Indicate the Beginning of Each Month

Installation Schedule

