ERDC/CERL TR-01-29

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Engineer Research and Development Center

Site Evaluation for Application of Fuel Cell Technology

Barksdale Air Force Base, LA

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Construction Engineering Research Laboratory

Foreword

In fiscal years 93 and 94, Congress provided funds for natural gas utilization equipment, part of which was specifically designated for procurement of natural gas fuel cells for power generation at military installations. The purchase, installation, and ongoing monitoring of 30 fuel cells provided by these appropriations has come to be known as the "DoD Fuel Cell Demonstration Program." Additional funding was provided by: the Office of the Deputy Under Secretary of Defense for Industrial Affairs & Installations, ODUSD (IA&I)/HE&E; the Strategic Environmental Research & Development Program (SERDP); the Assistant Chief of Staff for Installation Management (ACSIM); the U.S. Army Center for Public Works (CPW); the Naval Facilities Engineering Service Center (NFESC); and Headquarters (HQ), Air Force Civil Engineer Support Agency (AFCESA).

The work was performed by the Energy Branch (CF-E), of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was Michael J. Binder. Part of this work was performed by Science Applications International Corp. (SAIC), under Contract DACA88-94-D-0020, task orders 0002, 0006, 0007, 0010, and 0012. The technical editor was William J. Wolfe, Information Technology Laboratory. Larry M. Windingland is Chief, CEERD-CF-E, and L. Michael Golish is Chief, CEERD-CF. The associated Technical Director was Gary W. Schanche. The Acting Director of CERL is William D. Goran.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Director of ERDC is Dr. James R. Houston and the Commander is COL James S. Weller.

Contents

Foreword 2

List of Figures and Tables 4

1 Introduction 5

Background 5
Objective 6
Approach 6
Units of Weight and Measure 7

2 Site Description 8

Site Layout 9
Electrical System 9
Steam/Hot Water System 10
Space Heating System 10
Space Cooling System 10
Fuel Cell Location 10
Fuel Cell Interfaces 11

3 Economic Analysis 14

4 Conclusions 18

Appendix: Fuel Cell Site Evaluation Form 19

CERL Distribution 25

Report Documentation Page 26

List of Figures and Tables

Figures

1 Barksdale AFB Hospital site layout 9
2 Fuel cell locations and site interfaces 11
3 Thermal interface diagram 12

Tables

1 Companion ERDC/CERL site evaluation reports 7
2 Natural gas consumption for the Barksdale AFB Hospital, FY95 12
3 Barksdale AFB electricity consumption and costs 14
4 Electric rate schedule 14
5 Barksdale AFB natural gas consumption and costs 15
6 Barksdale AFB economic savings of fuel cell installation 17

1 Introduction

Background

Fuel cells generate electricity through an electrochemical process that combines hydrogen and oxygen to generate direct current (DC) electricity. Fuel cells are an environmentally clean, quiet, and a highly efficient method for generating electricity and heat from natural gas and other fuels. Air emissions from fuel cells are so low that several Air Quality Management Districts in the United States have exempted fuel cells from requiring operating permits. Today's natural gas-fueled fuel cell power plants operate at electrical conversion efficiencies of 40 to 50 percent; these efficiencies are predicted to climb to 50 to 60 percent in the near future. In fact, if the heat from the fuel cell process is used in a cogeneration system, efficiencies can exceed 85 percent. By comparison, current conventional coal-based technologies operate at efficiencies of 33 to 35 percent.

Phosphoric Acid Fuel Cells (PAFCs) are in the initial stages of commercialization. While PAFCs are not now economically competitive with other more conventional energy production technologies, current cost projections predict that PAFC systems will become economically competitive within the next few years as market demand increases.

Fuel cell technology has been found suitable for a growing number of applications. The National Aeronautics and Space Administration (NASA) has used fuel cells for many years as the primary power source for space missions and currently uses fuel cells in the Space Shuttle program. Private corporations have recently been working on various approaches for developing fuel cells for stationary applications in the utility, industrial, and commercial markets. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) have actively participated in the development and application of advanced fuel cell technology since fiscal year 1993 (FY93). CERL has successfully executed several research and demonstration work units with a total funding of approximately $55M.

As of November 1997, 30 commercially available fuel cell power plants and their thermal interfaces have been installed at DoD locations, CERL managed 29 of these installations. As a consequence, the Department of Defense (DoD) is the owner of the largest fleet of fuel cells worldwide. CERL researchers have developed a methodology for selecting and evaluating application sites, have supervised the design and installation of fuel cells, and have actively monitored the operation and maintenance of fuel cells, and compiled "lessons learned" for feedback to manufacturers. This accumulated expertise and experience has enabled CERL to lead in the advancement of fuel cell technology through major efforts such as the DoD Fuel Cell Demonstration, the Climate Change Fuel Cell Program, research and development efforts aimed at fuel cell product improvement and cost reduction, and conferences and symposiums dedicated to the advancement of fuel cell technology and commercialization.

This report presents an overview of the information collected at Barksdale Air Force Base (AFB), Bossier City, LA along with a conceptual fuel cell installation layout and description of potential benefits the technology can provide at that location. Similar summaries of the site evaluation surveys for the remaining 28 sites where CERL has managed and continues to monitor fuel cell installation and operation are available in the companion volumes to this report (Table 1).

Objective

The objective of this work was to evaluate Barksdale AFB as a potential location for a fuel cell application.

Approach

On 10 and 11 September 1996, CERL and SAIC representatives visited the Pine Bluff Arsenal (the site) to investigate it as a potential location for a 200 kW fuel cell. A design review meeting was held 20 March 1997. An Acceptance Test and the Fuel Cell Dedication took place 24 July 1997. This report presents an overview of information collected at the site along with a conceptual fuel cell installation layout and description of potential benefits.

Table 1. Companion ERDC/CERL site evaluation reports.

Location	Report No.
Fort Bliss, TX	TR 01-13
Fort Eustis, VA	TR 00-17
Fort Huachuca, AZ	TR 00-14
Fort Richardson, AK	TR 00-Draft
Picatinny Arsenal, NJ	TR 00-24
Pine Bluff Arsenal, AR	TR 01-15
U.S. Army Soldier Systems Center, Natick, MA	TR 00-Draft
U.S. Military Academy, West Point, NY	TR 00-Draft
Watervliet Arsenal, Albany, NY	TR 00-Draft
911th Airlift Wing, Pittsburgh, PA	TR 00-18
934th Airlift Wing, Minneapolis, MN	TR 00-19
Barksdale Air Force Base (AFB), LA	TR 01-29
Davis-Monthan AFB, AZ	TR 00-23
Edwards AFB, CA	TR 00-Draft
Kirtland AFB, NM	TR 00-Draft
Laughlin AFB, TX	TR 00-Draft
Little Rock AFB, AR	TR 00-Draft
Nellis AFB, NV	TR 01-31
Westover Air Reserve Base (ARB), MA	TR 00-20
Construction Battalion Center (CBC), Port Hueneme, CA	TR 00-16
Naval Air Station Fallon, NV	TR 00-15
Naval Education Training Center, Newport, RI	TR 00-21
Naval Hospital, Marine Corps Base Camp Pendleton, CA	TR 00-Draft
Naval Hospital, Naval Air Station Jacksonville, FL	TR 01-30
Naval Oceanographic Office, John C. Stennis Space Center, MS	TR 01-3
Subase New London, Groton, CT	TR 00-Draft
U.S. Naval Academy, Annapolis, MD	TR 00-22
National Defense Center for Environmental Excellence (NDCEE), Johnstown, PA	TR 01-33
Naval Hospital, Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, CA	TR 01-32

Units of Weight and Measure

U.S. standard units of measure are used throughout this report. A table of conversion factors for Standard International (SI) units is provided below.

1 ft	=	0.305 m
1 mile	=	1.61 km
1 acre	=	0.405 ha
1 gal	=	3.78 L
°F	=	°C (X 1.8) + 32
1 ton (cooling)	=	12,000 Btu

2 Site Description

Barksdale AFB is located adjacent to Bossier City, LA, near Shreveport in the northwestern corner of the State. The ASHRAE design temperatures for the site are 99 and 20 °F. Weather data for 1993 and 1994 showed extremes of 93 and 18 °F. During the past 10 years, the site averaged 2,243 heating degree days and the 2,487 cooling degree days. The cooling season extends almost year round. The elevation is approximately 250 ft and humidity is relatively high in the summer.

Barksdale AFB has been in operation since 1933. It is home to the Eighth Air Force, 2nd Bomb Wing, and 917th Fighter Wing. The Eighth Air Force is one of the three numbered air forces in the Air Combat Command. It serves as a total force war fighting headquarters, employing decisive global air power for U.S. Atlantic Command and U.S. Strategic Command. The Eighth Air Force maintains a variety of aircraft with deployment capabilities worldwide. The air power includes heavy bomber force composed of the B-1, B-52, and F-111 aircraft. The Eighth Air Force also operates the Air Force's C-130 transports, HH-60s, F-15s, F-16s, and A-10s. The 2nd Bomb Wing is a Wing of Strategic Air Command. They have three squadrons of B-52H Stratofortress bombers and provide flexible, responsive, global capability, autonomously or in concert with other forces. The 2nd Wing trains all Air Combat Command and Air Force Reserve B-52 crews.

Based on discussions with site personnel, the evaluation for application of the fuel cell focused upon the hospital. The hospital uses a hot water reheat system for the air conditioning system on a year-round basis; the same system supplies space heating in the winter. Hot water is supplied at 110 to 125 °F for both reheat and space heating. The boilers provide 375 °F saturated steam to the heat exchangers for these thermal loads. Domestic hot water is supplied to the hospital at 125 °F. Major changes to the hospital's mechanical and electrical systems are currently underway.

The Barksdale AFB hospital is located in the southwestern corner of the base. The hospital was designed for 110 beds, but is presently set up for 25. The hospital is currently being converted to a "super clinic." There is an adequate natural gas line and electric transformer in the mechanical and electrical rooms respectively. Make up water and telephone lines are available. More specific interface information for the site is provided in the “Fuel Cell Interfaces” section of this chapter.

Site Layout

The mechanical and electrical rooms are located on the second floor mezzanine of the hospital (Figure 1). The air handlers, heat exchangers, domestic hot water heaters, and existing boilers are located in the mechanical room. The new chillers, new boilers, cooling tower, and transformers included in the hospital renovation currently underway, are located across the loading dock east of the hospital.

Electrical System

A 13.2 kV electric line serves two 750 kVA transformers that provide 277/480 V power to the hospital. The hospital has a peak electric demand that exceeds 450 kW and would be able to consume most of the fuel cell's electrical output. The electrical demand appears to dip below 200 kW for short periods. There are presently two, 500 kW back-up generators. There are no significant requirements for using the fuel cell as an emergency generator.

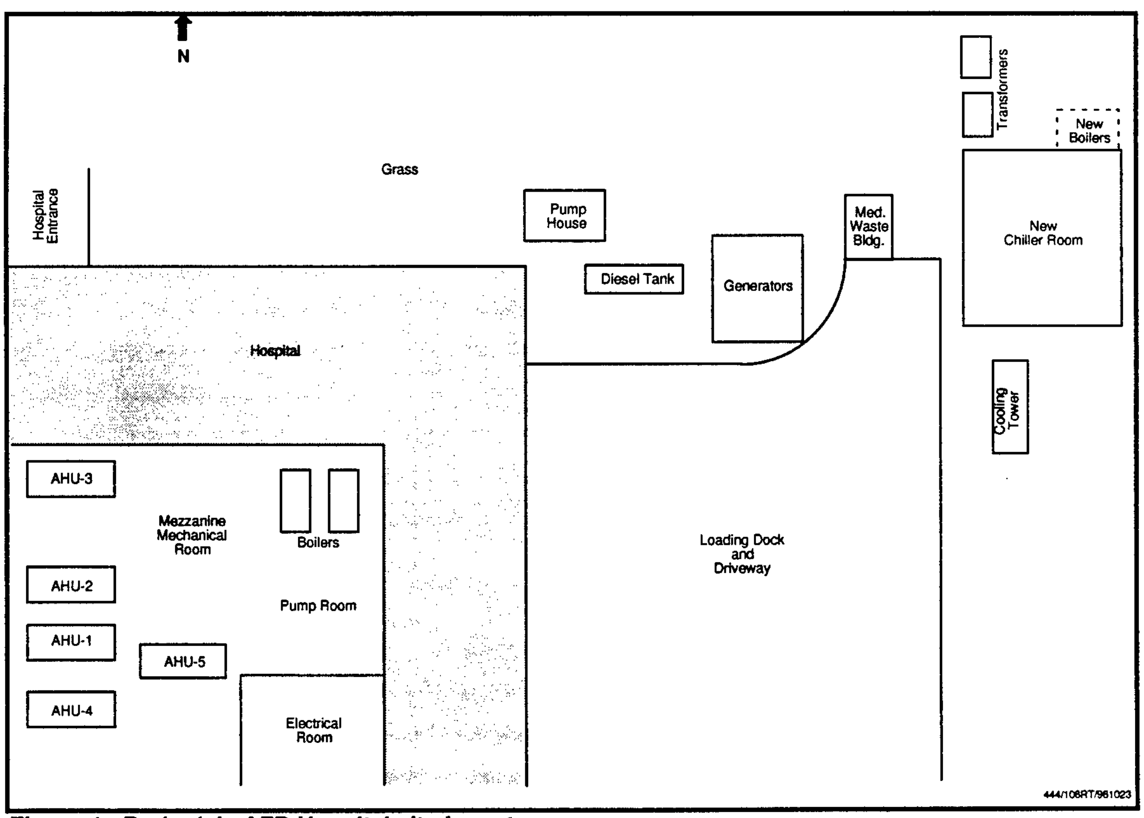

Figure 1. Barksdale AFB Hospital site layout.

Steam/Hot Water System

There are two, 300 hp boilers in the mechanical room of the hospital, which produce 375 °F saturated steam that is provided to the space heat and reheat heat exchangers and the domestic hot water heater. They are being replaced by two, 140 hp boilers which will be located near the new chiller room outside the hospital. Steam lines will be run up the northeast corner of the hospital to the mezzanine. Some small amounts of steam are used directly for sterilization, cooking, and humidification. Hot water is supplied at 125 °F and is stored in two, 910-gal tanks.

Space Heating System

The two, 300 hp boilers in the mechanical room (soon to be replaced) produce steam that is used to produce 110 to 125 °F hot water, which is distributed to five air handlers for space heating and reheat for the air conditioned air. The chillers operate year round.

Space Cooling System

Two new 255 ton Trane screw chillers provide 44 to 46 °F chilled water to the five air handling units for space cooling. Air is delivered at 55 °F. A new 250 ton Tecochill engine driven chiller is used to provide back up chilling capacity.

Fuel Cell Location

The proposed fuel cell location is at the northeast corner of the hospital (Figure 2). There is adequate room around the fuel cell to maintain the desired spacing.

The electrical connection to the electrical panels in the hospital mezzanine will require a 200-ft run. The fuel cell thermal lines will also be run approximately 200 ft to the space heating/reheat heat exchanger in the second floor mezzanine. The natural gas line can be connected to the gas line presently feeding the existing boilers in the mezzanine mechanical room, which is a piping run of approximately 200 ft. All lines are proposed to be run up the northeast corner of the hospital to the mechanical room. The hospital entrance is located on the north side and the fuel cell will be visible to those entering the hospital. Due to the close proximity to the entrance, the fence around the fuel cell would likely be wood instead of chain link. The wood fence will be the responsibility of the base.

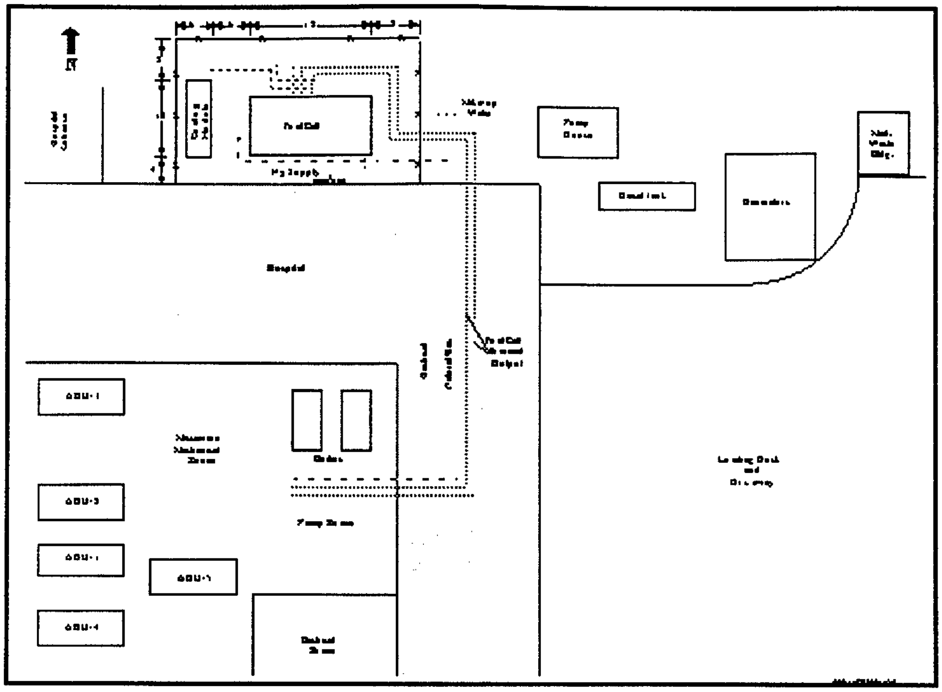

Figure 2. Fuel cell locations and site interfaces.

Fuel Cell Interfaces

The hospital electric service is being completely refurbished. There are two existing 750 kVA, 480/13,200 V transformers in the electrical room. These will be replaced with two 1,500 kVA, 480/13,200 V transformers which will be located outside. It is recommended that the fuel cell be grid connected at one of the new 480 V panels in the electrical room. It appears that nearly all of the fuel cell electrical output will be used in the hospital. The observed hospital electrical demand at the time of the site visit was approximately 450 kW. If the hospital load drops below the 200 kW fuel cell output, the excess electricity will feed back through the transformer into the base grid. The hospital has two 500 kW diesel back-up generators. There is no need to use the back-up power capability of the fuel cell.

The fuel cell thermal output should be used to heat the hydronic loop for space heating and air conditioning reheat. The steam heat exchanger supplies 110 to 125 °F hot water to the coils in the air handling units for space heating and 110 °F hot water for reheat. The hospital uses air conditioning and reheat 12 months of the year. These supply temperatures can be met by the standard fuel cell heat exchanger. Using a 25 gpm pump, a portion of the return water should be extracted from the return line, heated in the fuel cell, and returned to the return line prior to the steam heat exchanger (Figure 3).

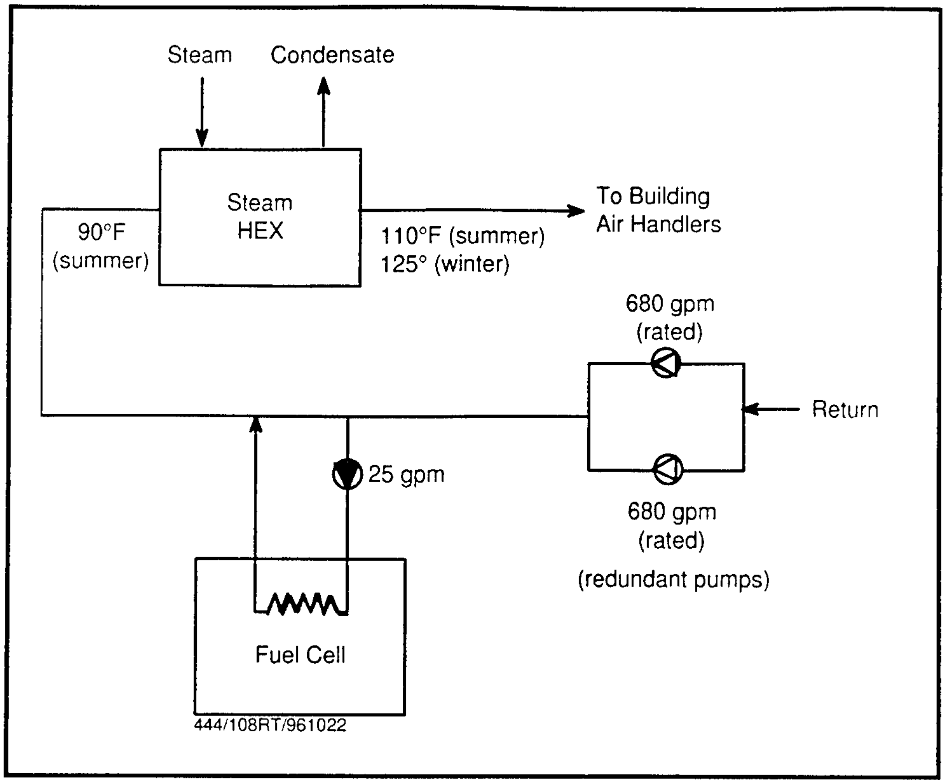

Figure 3. Thermal interface diagram.

Table 2. Natural gas consumption for the Barksdale AFB Hospital, FY95.

Date	Consumption (CCF)
Oct 94	15,807
Nov 94	13,193
Dec 94	23,128
Jan 95	26,695
Feb 95	14,817
Mar 95	14,817
Apr 95	14,620
May 95	12,694
Jun 95	16,742
Jul 95	10,159
Aug 95	12,151
Sep 95	12,151

Table 2 lists natural gas consumption for the hospital for FY95. The hospital's lowest monthly natural gas usage was 10,159 CCF in July 1995. The minimum average thermal load based on the gas consumption, assuming a 70 percent boiler efficiency was 984 kBtu/hr.

984 kBtu/hr 10,159 CCF/mo * 0.70 eff * 100 CF/CCF * 1,030 Btu/CF * 1 mo/744 hr.
* 1 kBtu/1,000Btu

The gas supplied to the hospital is used for space heat, reheat, domestic hot water, sterilization, steam cooking, and humidification (in some areas). To estimate the amount of gas used for the space heat/reheat, estimates of the other loads must be subtracted from the total load. Site personnel indicated that make-up water to the boilers ranged from 10 to 50 gal/hr. This would represent the steam lost during sterilization and humidification. If it is assumed that the average make-up requirement is 25 gal/hr, the sensible heat gain is 63 kBtu/hr.

63 kBtu/hr = 25 gal/hr 8.3 lb/gal * Btu/lb-°F (375 - 70)°F 1 kBtu/1,000 Btu

The latent heat, which is the heat required to produce steam, is calculated as follows:

208 kBtu/hr = 25 gal/hr * 8.3 lb/gal * 1,000 Btu/lb * 1 kBtu/1,000 Btu

Based on ASHRAE estimates, the hospital uses 18.4 gal/day per bed for domestic hot water. With 25 beds in operation at the hospital, the DHW load is 9 kBtu/hr.

9 kBtu/hr 18.4 gal/day-bed * 25 beds 1 day/24 hr * 8.3 lb/gal * 1 Btu/lb-°F
* (125 - 70)°F * 1 kBtu/1,000 Btu

If it is assumed that the thermal energy required for steam cooking is minimal, the total thermal energy required for space heating and air conditioning reheat is 704 kBtu/hr.

704 kBtu/hr 984 kBtu/hr - 63 kBtu/hr - 208 kBtu/hr - 9 kBtu/hr

This represents 100 percent of the fuel cell's 700 kBtu/hr thermal output in the lowest space heat/reheat usage month. However, this is based on average natural gas usage for the hospital and individual days could be less. Therefore, it is conservatively assumed that 90 percent of the fuel cell's thermal output (630 kBtu/hr) will be used on an annual basis.

3 Economic Analysis

Barksdale AFB purchases electricity from Southwestern Electric Power Company (SWEPCO) under rate schedule Lighting and Power (rate code 1110) which has demand, energy charge, and fuel charge components. The energy charge is divided into three blocks: the first 500,000 kWh, the next 4,500,000 kWh, and all kWh above 5,000,000 kWh. The fuel charge is a per kWh rate that varies monthly and applies to all kWh. Table 3 presents the electricity consumption and costs from August 1995 to July 1996. The Site paid an average of $0.0384/kWh during this period. Table 4 gives the electric rate schedule.

Natural gas is purchased from ARKLA under its commercial gas service rate schedule. Table 5 lists natural gas consumption and costs for Barksdale AFB from August 1995 to July 1996. The Site pays a flat rate of $4.26/CCF (100 cu ft).

Table 3. Barksdale AFB electricity consumption and costs.

Date	KW	KWH	Total Cost	Fuel Charge $/KWH	Total $/KWH
Aug-95	14,868	8,020,800	$295,177	$0.019441	$0.0368
Sep-95	14,895	6,451,200	$245,352	$0.018251	$0.0380
Oct-95	12,898	6,307,200	$234,494	$0.018701	$0.0372
Nov-95	12,041	5,500,800	$210,015	$0.018871	$0.0382
Dec-95	9,739	5,486,400	$196,426	$0.018561	$0.0358
Jan-96	9,352	4,867,200	$181,986	$0.019321	$0.0374
Feb-96	10,057	4,838,400	$191,547	$0.020731	$0.0396
Mar-96	10,333	5,083,200	$198,548	$0.020461	$0.0391
Apr-96	12,124	5,817,600	$236,063	$0.021841	$0.0406
May-96	14,613	7,142,400	$290,235	$0.022241	$0.0406
Jun-96	14,819	7,329,600	$292,292	$0.021621	$0.0399
Jul-96	15,310	8,697,600	$332,235	$0.021351	$0.0382
Tot/Avg	**12,587**	**75,542,400**	**$2,904,370**	**$0.0201**	**$0.0384**

Table 4. Electric rate schedule.

Demand Charge	$5.00/kW
Energy Charge (first 500,000 kWh)	$0.0125/kWh
Energy Charge (next 4,500,000 kWh)	$0.00800/kWh
Energy Charge (above 5,500,000 kWh)	$0.00750/kWh
Fuel Charge (for all kWh, which varies each month)	$0.0201/kWh (average from Table 1)

Table 5. Barksdale AFB natural gas consumption and costs.

Date	CCF	Cost	$/CCF
Aug-95	65,089	$27,702	$0.426
Sep-95	45,356	$19,304	$0.426
Oct-95	115,440	$49,131	$0.426
Nov-95	236,583	$100,690	$0.426
Dec-95	390,627	$166,251	$0.426
Jan-96	325,124	$138,373	$0.426
Feb-96	193,991	$82,563	$0.426
Mar-96	330,181	$140,525	$0.426
Apr-96	151,631	$64,534	$0.426
May-96	70,491	$30,001	$0.426
Jun-96	61,060	$25,987	$0.426
Jul-96*	65,089	$27,702	$0.426
Tot/Avg	**2,050,662**	**$872,762**	**$0.426**

* July data not provided; assumed same as August

Electric savings from the fuel cell were calculated based on the fuel cell operating 90 percent of the year (1,576,800 kWh). The third energy charge block ($0.0075/kWh) was used to calculate energy charge savings. The average fuel charge from Table 2 was used for the fuel charge savings. Fuel cell demand, energy and fuel charge savings were calculated as:

Demand Savings:

200 kW * 12 mo * $5.00/kW = $12,000

Energy Charge Savings:

1,576,800 kWh * $0.0075/kWh = $11,826

Fuel Charge Savings:

1,576,800 kWh * $0.0201/kWh = $31,694

Total electric savings based on 100 percent demand savings would total $55,520.

The thermal utilization for the fuel cell was estimated previously at 90 percent, or an average of 630,000 kBtu/hr. Assuming a 70 percent displaced boiler efficiency, the fuel cell would displace 7,096 MBtu/year of natural gas at the hospital boilers.

7,096 MBtu/yr = (.630 MBtu/hr * 8,760 hrs/yr * 90% capacity factor) / 70% boiler eff.

Using a natural gas rate of \$4.26/CCF and a value of 1.03, a thermal cost savings of \$29,349 was calculated for the fuel cell:

$$\$29,349 = (7,096 \text{ MBtu} / 1.03 \text{ MBtu/ CCF}) * \$4.26/\text{CCF}$$

Barksdale AFB may be able to obtain a special gas rate for the fuel cell of \$3.00/MBtu. The fuel cell will consume 14,949 MBtu per year based on an electrical efficiency of 36 percent higher heating value (HHV) at a 90 percent capacity factor. At \$3.00/MBtu, input natural gas cost for the fuel cell would be \$44,847.

The net savings for the 90 percent thermal utilization case and 100 percent demand savings was calculated at \$40,022 (Table 6). Table 6 also presents fuel cell savings for 100 percent thermal savings and partial demand savings scenarios. If only 50 percent of the demand savings can be obtained due to the fuel cell's operation, then net savings would be \$34,022.

This analysis has given a general overview of the potential savings from the fuel cell. For the first 3 to 5 years (depending on remaining program funds after fuel cell options are selected for each Service branch), ONSI will be responsible for the fuel cell maintenance. Maintenance costs are not reflected in this analysis, but could represent a significant impact on net energy savings. Since detailed load energy profiles were not available, net energy savings could vary depending on actual thermal and electrical utilization.

Table 6. Barksdale AFB economic savings of fuel cell installation.

Case	ECF	TU	Displaced kWh	Displaced Gas (MBtu)	Electrical Savings	Thermal Savings	Nat. Gas Cost	Net Savings
Full Demand Savings								
Maximum Thermal Case	90%	100%	1,576,800	7,884	$55,520	$32,607	$44,847	$43,280
Base Case	90%	90%	1,576,800	7,096	$55,520	$29,349	$44,847	$40,022
50% Demand Savings								
Maximum Thermal Case	90%	100%	1,576,800	7,884	$49,520	$32,607	$44,847	$37,280
Base Case	90%	90%	1,576,800	7,096	$49,520	$29,349	$44,847	$34,022
Zero Demand Savings								
Maximum Thermal Case	90%	100%	1,576,800	7,884	$43,520	$32,607	$44,847	$31,280
Base Case	90%	90%	1,576,800	7,096	$43,520	$29,349	$44,847	$28,022

Assumptions:

Input Natural Gas Rate: $3.00/MBtu

Displaced Natural Gas Rate: $4.26/CCF ($4.136/MBtu)

Electric Rate: see report text

Fuel Cell Thermal Output: 700,000 Btu/hour

Fuel Cell Electrical Efficiency: 36%

Seasonal Boiler Efficiency: 70%

ECF = Fuel cell electric capacity factor

TU = Thermal utilization

4 Conclusions

This study estimates that the Barksdale AFB hospital represents a good application for a 200 kW phosphoric acid fuel cell. The net energy bill savings are expected to be $40,022/year with full demand savings. The fuel cell installation at the hospital is relatively straightforward, however, the piping and wiring runs are approximately 200 ft up to a second floor mezzanine.

The fuel cell is electrically compatible with the site. There will be two new 1,500 kVA 480 V/13.2 kV transformers. The space heating and air conditioning reheat load should use over 90 percent of the fuel cell's thermal output on a year-round basis.

This site will provide good visibility for the fuel cell with it being located in a grassy area on the entrance side of the hospital. A wood fence, which is required at the hospital, will be the responsibility of Barksdale AFB.

Appendix: Fuel Cell Site Evaluation Form

Site Name: **Barksdale AFB**
Location: **Bossier City, LA**

Contacts: **Nathan Cost**

1. Electric Utility: **Southwestern Power Co.**
   Contact: **N/A**
   Rate Schedule: Firm – **Lighting and Rate No. 1110**

2. Gas Utility: **ARKLA**
   Contact: **Jeff Wiese (318) 429-3059**
   Rate Schedule: **Commercial Gas**

3. Available Fuels: **Natural Gas, Diesel**
   Capacity Rate:

4. Hours of Use and Percent Occupied:
   25 bed hospital, originally designed for 110 bed hospital
   Weekdays __5__ Hrs __24__
   Saturday __1__ Hrs __24__
   Sunday __1__ Hrs. __24__

5. Outdoor Temperature Range: **ASHRAE design: 99°F high, 20 °F low, 93/94 Weather Data: 93 °F high, 18 ° low, 2,243 HDD; 2,487 CDD**

6. Environmental Issues: **no major issues**

7 Backup Power Need/Requirement: **Hospital has two 500 kW emergency generators and a 250-ton engine driven chiller for cooling backup.**

8. Utility Interconnect/Power Quality Issues: **none**

9. On-site Personnel Capabilities: **Most station maintenance is performed by base Civil Engineering**

10. Access for Fuel Cell Installation: **Very good.**

11. Daily Load Profile Availability: **No load profile is available**

12. Security: **no major security issues at hospital. A fence is required.**

Site Layout

Facility Type: **Hospital** Age: **25 years**

Construction: **Combination concrete block with brick veneer and steel structure with block and brick.**

Square Feet: **127,240**

See Figures 2, 3 & 4

Show: electrical/ thermal/gas/water interfaces and length of runs
drainage
building/fuel cell site dimensions
ground obstructions

Electrical System

Service Rating: **13.2 kV service to building, 480 volt service in building.**

Electrically Sensitive Equipment: **computers, hospital electronic medical equipment**

Largest Motors (hp, usage): **Two 255 ton screw chillers**

Grid Independent Operation?: **No**

Steam/Hot Water System

Description: **Hospital has its own independent steam system.**

System Specifications:

Fuel Type: **Natural Gas**

Max Fuel Rate:

Storage Capacity/Type: **None**

Interface Pipe Size/Description: **4 in.**

End Use Description/Profile: **There are two 300 HP boilers that produce 375 °F saturated steam that is converted into 125 °F hot water for space heating, air conditioning reheat, humidification, domestic hot water, and cooking. The boilers are being replaces with two 140 Hp boilers. DFW is stored in two 910 gallon tanks.**

Space Cooling System

Description: **Two new 255 ton Trane screw chillers and one 250 to Tecochill natural gas engine driven chiller for backup air conditioning.**

Air Conditioning Configuration:
Type:
Rating:
Make/Model:

Seasonality Profile:

Space Heating System

Description: **Two 300 Hp boilers (to be replace[d] by two 140 Hp boilers) in the mechanical room produce steam which is used to produce 110 °F to 125 °F hot water which is distributed to five air handlers for space heating and reheat for the air conditioned air. Chillers operate year round and the air is reheated if necessary.**

Fuel: **Natural Gas**

Rating:

Water supply Temp: **110 °F to125 °F**

Water Return Temp:

Make/Model:

Thermal Storage (space?): **None**

Seasonality Profile: **Air conditioning reheat is year round.**

CERL Distribution

Commander, Barksdale AFB
ATTN: 2CES/CEOE (2)

Chief of Engineers
ATTN: CEHEC-IM-LH (2)

Engineer Research and Development Center (Libraries)
ATTN: ERDC, Vicksburg, MS
ATTN: Cold Regions Research, Hanover, NH
ATTN: Topographic Engineering Center, Alexandria, VA

Defense Tech Info Center 22304
ATTN: DTIC-O

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12/00

REPORT DOCUMENTATION PAGE

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14. ABSTRACT

Fuel cells are an environmentally clean, quiet, and a highly efficient method for generating electricity and heat from natural gas and other fuels. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) have actively participated in the development and application of advanced fuel cell technology since fiscal year 1993 (FY93). CERL selected and evaluated application sites, supervised the design and installation of fuel cells, actively monitored the operation and maintenance of fuel cells, and compiled "lessons learned" for feedback to the manufacturer for commercially available fuel cell power plants installed at Department of Defense (DoD) locations.

This report presents an overview of the information collected at Barksdale Air Force Base, LA, along with a conceptual fuel cell installation layout and description of potential benefits the technology can provide at that location. Similar summaries of the site evaluation surveys for the remaining sites where CERL has managed and continues to monitor fuel cell installation and operation are available in the companion volumes to this report.

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