THE 2010 FLC MID-CONTINENT REGION ANNUAL AWARDS SAND2010-4756P

Nomination Form

Please note the specific criteria for the nominated award.

I nominate the following individual, technology, or organization for the following award (please √):

- ❑ Regional Laboratory Award
- ❑ Representative of the Year Award
- **Notable Technology Development Award**
- ❑ Regional Partnership Award
- ❑ STEM Mentorship Award (New Category!)
- ❑ Excellence in Technology Transfer

Nomination submitted by: Jackie Kerby Moore
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Nominee's Name: Lennie Klebanoff, Principal Member of the Technical Staff, Sandia National Laboratories, and the other 13 members of the Fuel Cell Mobile Lighting Project Team (identified within the nomination text)
Affiliation: Sandia National Laboratories
Laboratory Director/CEO or Point of Contact: Paul Hommert T#/email: 505-844-8789, pjhomme@sandia.gov

Basis for the nomination. Summarize in space below. Up to two additional pages of written justification may be appended. Total nomination should not exceed **two pages**, Times 12 pt, 1 ½ line spaced. Artwork, photographs are ***strongly*** encouraged and are not included in the page count.

Fuel Cell Mobile Light

Basis for Nomination—Notable Technology Development

In March 2008, Boeing invited Sandia to lead a joint effort to bring hydrogen fuel cell technology to airport ground support equipment. Although Boeing has an interest in using fuel cells actually "on-board" commercial aircraft, Boeing thought it would be wise to gain experience with the clean renewable technology first on the tarmac. However, recently, and with the aid of Department of Energy (DOE) funding, the project goals have broadened to bring clean energy technology (both lighting and H_2 fuel cells) to the construction marketplace, stimulate demand for hydrogen, and proliferate the technology. By doing so, our nation can reduce diesel emissions (both soot and particles), reduce greenhouse gas emissions (CO_2), and lower our dependence on foreign oil. In this project, focus was given to replacing diesel-fueled mobile lighting towers with a quiet, non-polluting Fuel Cell Mobile Light, as shown in Figure 1 below.

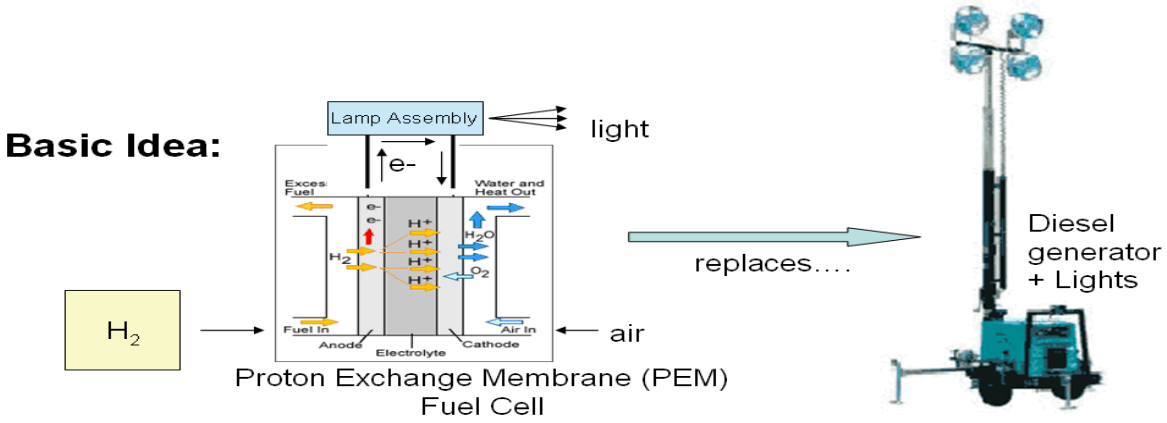

Figure 1: Replacing Diesel-based Mobile Lighting with pollution-free Fuel Cell Mobile Lighting

The Fuel Cell Mobile Light of Figure 1 is a reliable and attractive alternative to diesel-powered construction lighting, which currently dominates the market. The Fuel Cell Mobile Light is significantly quieter, and is certified as a "zero-emissions" system due to its use of a fuel cell fuelled with pure hydrogen. Additionally, the Fuel Cell Mobile Light technology has attracted businesses and organizations involved in road work, emergency roadway lighting, aircraft/airport maintenance, and disaster recovery. The film and entertainment industry had their curiosity piqued when a demonstration at Paramount Pictures in Hollywood showed that the system is remarkably quiet, and because there are no harmful emissions, the system could be used indoors (i.e., on a soundstage) in a very straightforward way. Diesel-fueled equipment cannot be used indoors due to harmful emissions.

This interest from many diverse applications led to the formation of a project team, combining 14 institutional partners comprised of new technology holders, mass manufacturing partners, and end users. Joining Sandia and Boeing are NASA, the California Department of Transportation (Caltrans), Multiquip, Inc. (the largest manufacturer of rental construction equipment in the US), the San Francisco International Airport (SFO), Altergy Systems (mass manufacturers of fuel cells), the California Fuel Cell Partnership (CAFCP), Golden State Energy, Lumenworks, Ovonic Hydrogen Systems, Saunders Electric, Stray Light Optical Technologies and Luxim, Inc. (manufacturers of state-of-the-art plasma lighting). Paramount Pictures is providing consultation for the project. The project team quickly made as its goal the development of a commercially available Fuel Cell Mobile Light.

As the first step to that goal, the project partners designed and fabricated an "alpha" model Fuel Cell Mobile Light. In the summer of 2009, Caltrans requested the alpha system be built in time to be shown in October 2009 at a meeting of the American Association of State Highway Transportation Officials (AASHTO), a gathering of the heads of the Department of Transportation for all 50 states. At this meeting, the Fuel Cell Mobile Light illuminated a showing of the latest models of electric vehicles. Feedback from the AASHTO attendees was excellent.

The Fuel Cell Mobile Light was used during the 82nd Annual Academy Awards ceremony held in Hollywood on March 7, 2010. During that event, seen by 43 million TV viewers in the US alone, the "alpha" unit provided lighting at an access point to the Red Carpet for the international press corps and production personnel. It also provided auxiliary power for a security metal detector used during the awards show.

Shining a New Light – With Hydrogen

Mobile lighting refers to small, portable lighting systems used primarily by highway construction crews, airport maintenance personnel, and even film crews. Traditionally, mobile lighting units are powered by diesel generators that produce CO_2, NO_x (nitrogen oxides produced during combustion), and soot, making them less than ideal for the environment. In addition, diesel units are noisy, which creates a safety hazard for those using them. A fuel cell running on pure hydrogen, on the other hand, is both very quiet and a zero-emission electric power source. Each deployed fuel cell-based mobile light would avoid burning nearly 900 gallons of diesel fuel per year and eliminate NO_x and soot emissions. If the hydrogen used is generated from non-fossil fuel sources, then each mobile light unit would also reduce CO_2 emissions by about nine metric tons per year.

To bring the Fuel Cell Mobile Light to the marketplace, Sandia formed a dynamic and diverse coalition consisting of funding sponsors, fuel cell and lighting technology experts, equipment manufacturers and end users. The project partners are shown in Figure 2 below:

Figure 2: The Fuel Cell Mobile Light Project Partners

An "alpha" prototype of the Fuel Cell Mobile Light (Figure 3 next page) was constructed using seed funding from Boeing and substantial in-kind contributions from the project partners. Altergy Systems and Multiquip, Inc. built the system with guidance from Sandia. The Fuel Cell Mobile Light, targeted for the market by the end of 2010, features an Altergy Systems FPS-5 5kW Proton Exchange Membrane (PEM) fuel cell running on pure hydrogen. The fuel cell produces electricity for an advanced, power-saving Light Emitting Plasma™ (LEP) lighting system, and also provides AC auxiliary power up to 1.5 kilowatts. The AC power allows equipment (such as drills, power tools, charging stations) to be powered by the unit at the same time the system is providing illumination. The fuel cell itself can convert 43% of the hydrogen fuel energy to electricity, which is substantially more efficient than diesel generators, which can convert only ~27% of the diesel fuel energy to electric power. Hydrogen is stored on the unit via two 5,000 psi composite hydrogen tanks.

A key component of the system is the LEP technology contributed by Luxim, Lumenworks, and Stray-Light Optical Technologies. Before this technology was introduced, mobile lighting units typically consumed 4.4 kilowatts of electrical energy. The LEP system only consumes about 1.8 kilowatts of power for the same light output. A more efficient lighting system like the LEP saves energy and increases the system duration (i.e. the operational time between hydrogen refills). The combined energy efficiencies associated with the LEP lighting, and the fuel cell make the Fuel Cell Mobile Light remarkably energy efficient.

Figure 3: The Alpha Fuel Cell Mobile Light

Going to Hollywood

Project partner Saunders Electric provides power for most of the entertainment industry's various awards shows. At the invitation of Russ Saunders, its president, our unit was invited to be part of the 82nd Annual Academy Awards held in Hollywood on March 7, 2010. Prior to the show, the system was demonstrated to the technical leads of the Academy of Motion Picture Arts and Sciences (AMPAS®), and met with their enthusiastic approval. Next, the system was shown to representatives of the Los Angeles Fire Department (LAFD) and the Los Angeles Building and Safety Department. Both LAFD and Building and Safety fully approved use of the technology at the Oscars.

In the week leading up to the Oscars event, the Fuel Cell Mobile Light was used by Academy construction personnel in the build-up of the famed Red Carpet area on Hollywood Blvd. (See figure 4 below.) The construction personnel used it like any other piece of equipment. When the unit needed to be refueled with hydrogen, the staff of Saunders Electric refueled it themselves.

Figure 4: Construction crews from the Academy of Motion Picture Arts and Sciences (A.M.P.A.S ®) use the Fuel Cell Mobile Light in Construction of the Red Carpet.

After the awards ceremony, Russ Sanders attended a post-Oscars debrief attended by about 60 individuals comprised of vendors, producers, technicians, engineers, and Academy personnel. In a letter to Sandia's Lennie Klebanoff, project lead, he wrote the debrief attendees were ***"quite excited at the developmental prospects and have instructed me to use these devices at my discretion on all events associated with the Academy's productions…. I have spoken with several production companies and independent producers in Hollywood concerning the integration of this system into production equipment orders and have met with very positive results."***

With a recently received $610K from DOE's Office of Energy Efficiency and Renewal Energy (EERE) and with $150K from Boeing, the project's near-term focus is on the construction of six "near-commercial" units that will be subjected to rigorous environmental and performance testing. The testing will allow Multiquip to finalize the commercial design and offer the unit for sale with full warranty by the end of this year. Caltrans will use a unit in its road repair and graffiti removal work in the Los Angeles Basin in the fall, exposing the unit to rough handling. SFO will test a unit against the threat of rust, salt, rain, and wind so common at that facility. Disneyland will get a unit for use in its stage shows and after-hours maintenance operations. Boeing will test a unit in its Paine Field operations where there is flight-testing with the new 787 aircraft. The Everett, WA, location will challenge the system with sleet, rain, ice, and foggy conditions. A unit will also go to NASA's Kennedy Space Center (KSC) in Florida for exposure to heat, humidity, and salt air. KSC will use the system for public events, night work on launch platforms, and also to illuminate the last Space Shuttle launch in the fall of 2010. Finally, the project will construct a Fuel Cell Mobile Light optimized for the entertainment industry with sound conditioning in the enclosure, thereby bringing to an absolute minimum any generated noise. The entertainment industry unit will be used by Paramount Pictures in its studio work, and by Saunders Electric to support its work in television and film.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.