Developing fuel cell-powered mobile lighting application

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Luxim and Lumenworks manufacture and design the plasma lighting sources and reflectors used in the fuel cell-powered mobile lighting system spearheaded by Sandia. Here, the first outdoor test of the lighting assembly is successfully conducted. Credit: Photo courtesy Stray Light Optical Technologies

Sandia National Laboratories, with help from The Boeing Company, the California Department of Transportation (Caltrans), and others, is leading an effort to develop a commercially viable, fuel cell-powered mobile lighting system.

"Mobile lighting" refers to small, portable lighting systems that are used primarily by highway construction crews, airport maintenance personnel,

and even film crews.

"The beauty of this project is that it ties together the manufacturers [Multiquip, Altergy Systems, Luxim, Lumenworks, Stray Light] with Sandia and the end users [Caltrans, San Francisco International Airport] in one collaboration, hopefully reducing commercialization barriers that so often hinder the widespread use of new technology," said Sandia project lead Lennie Klebanoff. The end goal of the project, according to Klebanoff, is to get fuel cell technology into more widespread commercial use, particularly in general construction and aviation maintenance applications.

Two separate designs

Sandia has adopted a two-prong (alpha and beta) approach to the project. First, along with a number of the external partners who are contributing time and in-kind resources, Klebanoff's team is overseeing the production of the "alpha" mobile lighting unit that is expected to debut Oct. 22-26 at the annual meeting of the American Association of State Highway and Transportation Officials (AASHTO). The alpha unit is separate from the more advanced "beta" design that Sandia recently completed for Boeing and came about due to the enthusiasm of several industry partners and their desire to see a system built sooner rather than later.

"Caltrans wanted us to get the alpha version in front of their highway transportation peers immediately, and our unit will be in operation and actually illuminating the new electric cars being featured at the AASHTO meeting," said Klebanoff. "It will give all of us good feedback on how interested potential customers are in the technology, and also allow us to get an initial assessment of how the technology performs, particularly the plasma lighting."

The alpha system consists of advanced power-saving Light Emitting PlasmaTM technology (contributed by Luxim, Lumenworks, and Stray Light), two high-pressure hydrogen tanks (purchased by Sandia), a trailer to transport the equipment (provided by Multiquip), and a fuel cell (provided and installed by Altergy Systems). Multiquip and Altergy are assembling the overall unit, while Sandia has consulted on its design and formulated the alpha unit technical plan for the team.

The project has also attracted the interest of SFO, a long-time partner with Sandia on various homeland security projects. SFO would like to test the system for use in nighttime runway repair work, as well as in its terminal renovation activities. Unlike the diesel systems that traditionally power mobile lighting units, the fuel cell-powered mobile light can be used indoors.

Boeing design will use metal hydride storage

Boeing funded Sandia primarily to develop the "beta" design, a more sophisticated, technically ambitious unit that utilizes metal hydride storage tanks designed by Ovonic Hydrogen Systems. These tanks store 12 kilograms of hydrogen, and thus offer some 90 hours of operating time (compared to the 30-40 hours offered by the alpha unit). Sandia's engineers designed the overall beta system and solved the thermal management issues that surround metal hydride storage, including coupling waste fuel cell heat to the hydride bed. Metal hydride storage is also appealing since it removes many of the safety concerns found with having high pressure on the Alpha unit (whose tanks hold hydrogen at 5000 psi, compared to 250 psi with the metal hydride tank system). These are all important considerations for commercialization, Klebanoff said.

Other funding sources, he said, are being sought so that the beta system can be built and both versions of the system can then be tested and

compared on equal terms. The team would also like to use the field-test data to perform quantitative analyses of the emissions reductions and increased energy efficiency afforded by the technology. Ultimately, Klebanoff said, it will be the manufacturers who decide which system is most attractive for commercial purposes.

Traditionally, mobile lighting units are powered by diesel fuel 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 when construction personnel are distracted and can't hear oncoming traffic. A fuel cell running on pure hydrogen, on the other hand, is both very quiet and a zero-emission electric power source.

Klebanoff estimates that each deployed fuel cell-based mobile light would avoid the burning of nearly 900 gallons of diesel fuel per year and eliminate the emission of NO_x and soot. 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.

Source: Sandia National Laboratories