NASA TECHNOLOGY EVALUATION FOR ENVIRONMENTAL RISK MITIGATION

Project Profile: Hydrogen Fuel Cell Mobile Lighting Tower (HFCML)

NASA is committed to finding innovative solutions that improve the operational performance of ground support equipment while providing environment and cost benefits, as well. Through the Hydrogen Fuel Cell Mobile Lighting Tower (HFCML) project, NASA gained operational exposure to a novel application of high efficiency technologies.

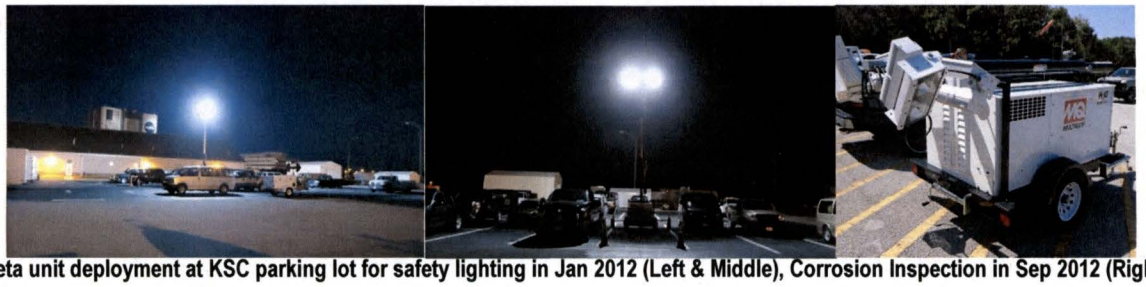
Alpha unit used during final Shuttle launch in Jul 2011

Traditionally, outdoor lighting and auxiliary power at security gates, launch viewing sites, fallback areas, outage support, and special events is provided by diesel generators with metal halide lights. Diesel generators inherently contribute to CO_2, NO_x, particulate emissions, and are very noisy.

In 2010, engineers from NASA's Technology Evaluation for Environmental Risk Mitigation Principal Center (TEERM) introduced KSC operations to a novel technology for outdoor lighting needs. Developed by a team led by Sandia National Laboratory (SNL), the technology pairs a 5kW hydrogen fuel cell with robust high efficiency plasma lights in a towable trailer. Increased efficiency, in both the fuel cell power source and lighting load, yields longer run times between fueling operations while providing greater auxiliary power. Because of the unit's quiet operation and no exhaust fumes, it is capable of being used indoors and in emergency situations, and meets the needs of all other operational roles for metal halide/diesel generators. The only discharge is some water and warm air. Environmental benefits include elimination of diesel particulate emissions and estimated 73% greenhouse gas emissions savings when the hydrogen source is natural gas (per GREET model). As the technology matures the costs could become competitive for the fuel cell units which are approximately 5 times diesel units.

Initial operational concerns included the hydrogen storage tanks and valves, lightning safety/grounding, and required operating and refueling procedures. TEERM facilitated technical information exchange (design drawings, technical standards, and operations manuals) necessary for KSC hydrogen system experts to approve use of the HFCML unit, including initiating the environmental checklist (i.e. exterior lighting waiver due to sea turtles), and development of operations and maintenance instructions. TEERM worked with SNL to establish a bailment agreement for KSC to utilize a Beta unit as part of normal Center Operations for a period of twelve months.

All interested stakeholders were invited to witness the technology and provide feedback at an initial demonstration and orientation using an Alpha unit in April 2011. A second demonstration was conducted in conjunction with the final Shuttle launch in July 2011 where the technology received international press coverage. A Beta unit arrived in September 2011 and deployed to an unlit parking lot of a newly constructed KSC building, thus avoiding a potential safety hazard during second shift. TEERM photographed the unit periodically to document corrosion, refueling operations, and relayed issues back to SNL. The unit operated an estimated 66 hours between each refueling approximately 12-14 hours a night during a work week. Refueling operations were performed at the Propellants North Hydrogen Storage Area. While the actual act of replenishing hydrogen into the tanks took about 15-20 minutes, the process of stowing and transporting the unit back and forth for redeployment used up a considerable amount of resources. The HFCML was filled five times with an approximate total of 21,200 standard cubic feet of hydrogen.



Beta unit deployment at KSC parking lot for safety lighting in Jan 2012 (Left & Middle), Corrosion Inspection in Sep 2012 (Right)

During deployment, KSC corrosion experts inspected the unit. No major issues were encountered with any of the components (i.e. all of the lights worked; evaluations at other demonstration sites resulted in plasma lights becoming inoperable.) The Beta unit was returned to SNL; the winching system was replaced (due to corrosion), LED lights were retrofitted to replace the plasma lights, and redeployed at San Francisco International Airport. This successful demonstration exemplifies the strong relationship between NASA and DOE as exposure to KSC's corrosive environment and end user feedback helped bring the unit closer to commercialization (forecasted to become available for rent/purchase in late 2013).