



# California Energy Commission

Alternative & Renewable Fuel & Vehicle Technology Program

## **Fuel Cell Powered Lighting Tower To Replace Diesel Engine**

Presented by:

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**Golden State Energy**

April 27, 2009

Fuel Cell  
Powered  
Christmas Tree  
2008



# Origin: Boeing Interested in Bringing Fuel Cell Technology to Ground Support Equipment (GSE)

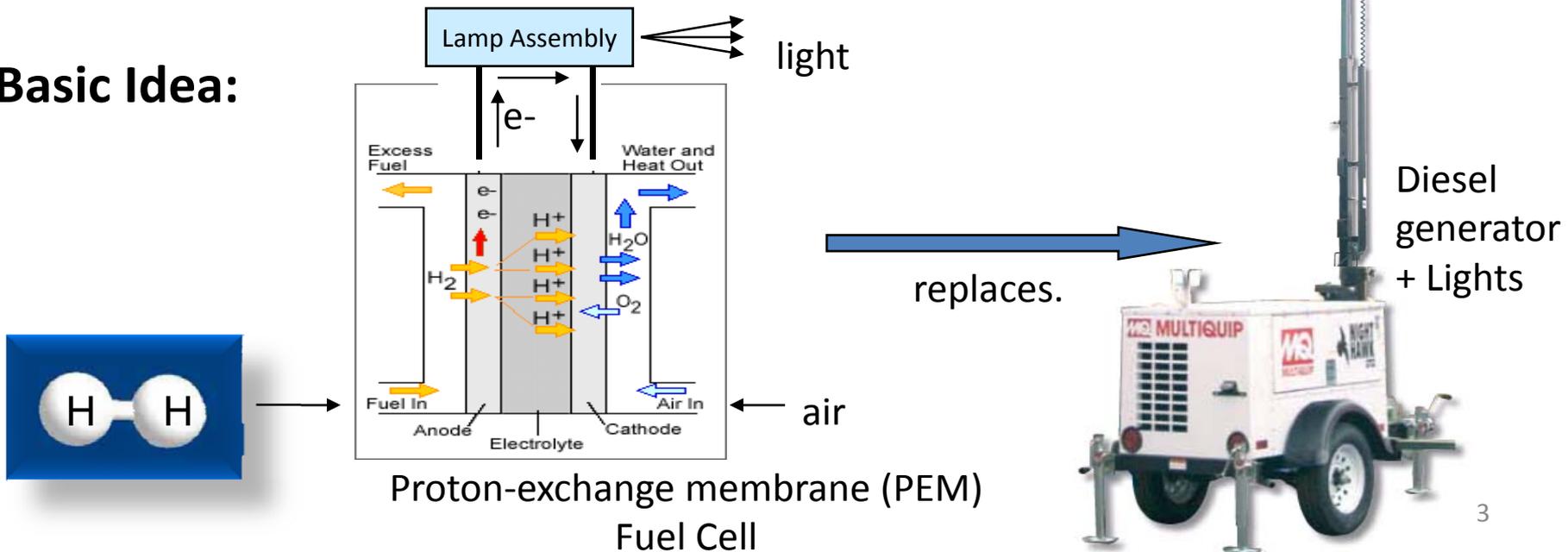
3/1/2008:

“We (Boeing) would like Sandia to lead an effort with us to bring hydrogen fuel cell technology to ground support equipment, starting at LAX”

-- George Roe, Manager of Subsystems Technology,  
Boeing Phantom Works

Initial discussions settle on a H<sub>2</sub> fuel cell demonstration for mobile 5 kW aircraft maintenance lighting:

Basic Idea:



# Team Members Have Established Funding Goal to Design, Build, & Demonstrate the H<sub>2</sub> Fuel Cell Mobile Light System

## Team Members

✘ Sandia National Laboratories—Technical Lead

✘ Caltrans

✘ Boeing

✘ Golden State Energy

✘ California Fuel Cell Partnership

✘ LUMENWORKS/LUXIM

✘ Virginia Tech

✘ MultiQuip

✘ Alteryg Systems



Financial Goal

\$1,500,000



Cash & In-Kind  
Value Total

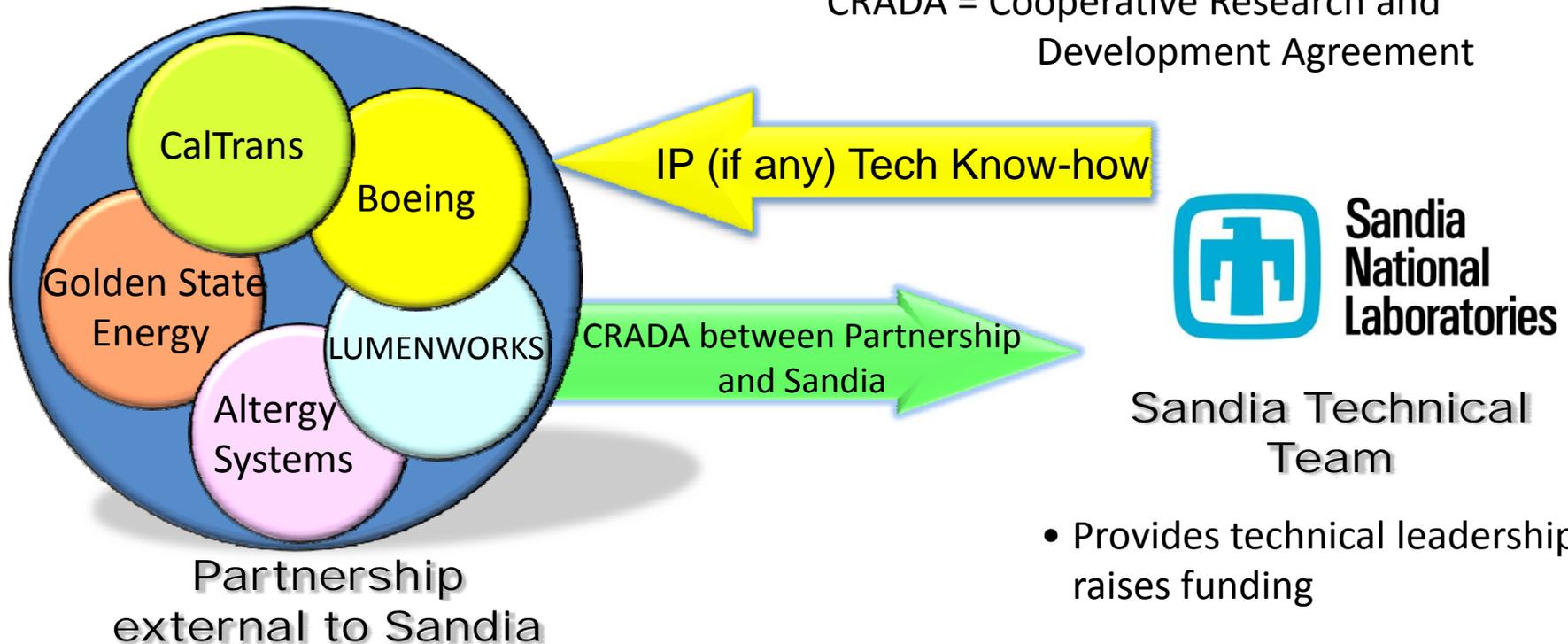
\$264,000



LUMENWORKS

# Proposed Partnership Arrangement

CRADA = Cooperative Research and Development Agreement



- Defines work, provides funds to Sandia, in-kind contributions, technical collaboration, manages IP

- Provides technical leadership, raises funding
- Performs design work
- Builds, tests and demonstrates prototype in collaboration with partners

# **MQ** MULTIQUIP Light Towers



**Dependable jobsite lighting**

## **Platform for Transformation**

### **Environmental Problems with Diesel-based Lighting:**

- Emit carbonaceous particles & PM
- Produce CO<sub>2</sub> and other GHG
- Produces Toxic Air Contaminates
- Hazardous to health from emissions
- Wasted energy due to inefficiencies
- Are noisy, distracting workers
- High Glare/stray light, safety concern
- Does not meet Dark Sky Initiative

***MultiQuip wants to commercialize  
The H<sub>2</sub>/Fuel Cell Mobile Light  
and introduce the technology  
into the construction equipment  
marketplace***

**Construction Starts Here**

[www.multiquip.com](http://www.multiquip.com)



# Modular Light Towers

Multiquip MLT-Series modular light towers combine a rugged frame with your choice of either a high quality Multiquip DA7000SSW generator or SDW225SS generator/welder. Each power unit delivers the features you've come to expect from Multiquip such as brushless design and excellent voltage regulation. Simple mounting requirements provide the ability to exchange power sources with minimal delay. This unique design provides greater versatility than any other light tower on the market.

Ballasts and light switches for the MLT Series are conveniently located in the tongue area of the trailer. This provides the ability to illuminate an area even without running the generator. Simply connect the power cord to an alternate power source and you can operate the light fixtures. This is a great feature for special events requiring either low noise levels or zero emissions.

*Our MLT-Series modular light towers are so reliable and durable that we offer a 3-year/3,000 engine hour warranty on the entire unit.*



Lights can be rotated 360°

Outstanding wind stability with outriggers and jack stands deployed — 72 mph with genset; 45 mph trailer only.

Light tower may be purchased less power source as model MLT.

## Modular design lets you choose the power source...

**MLTDA7 —  
7KW 3600 RPM Generator**



65 dBA

Combine the MLT with a DA7000SSW (MLTDA7) for a compact light tower that offers the best sound attenuation in the industry.

- AC output: 7kW maximum; 6kW continuous
- Brushless alternator design greatly minimizes service time.
- Liquid-cooled 12.5 HP Kubota diesel engine\*
- Quiet operation — 65.7dBA @ 23 feet.

**MLTSDW7 —  
7KW AC Generator/  
225 Amp Welder Combo**



Combine the MLT with an SDW225SS (MLTSDW7) for the industry's only light tower offering the versatility of a premium generator and CC/CV welding capability.

- AC output: 7kW maximum; 6kW continuous
- Outstanding arc characteristics for welding pipe or structural steel.
- Liquid-cooled 12.5 HP Kubota diesel engine\*
- Quiet operation — 68.7dBA @ 23 feet.

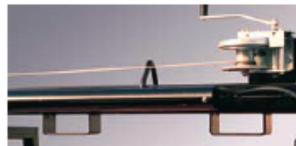
### These power sources feature...

- Exterior service drains
- Full range of convenience receptacles
- Lockable Control Panels
- 48 hours+ runtime
- Quiet operation — 70 dB or less



Fan

Fan-cooled Ballast Box resides in the tongue of the trailer in a watertight compartment. Control breaker switches for the lights are easily accessible.



Heavy-duty brake winches telescope the mast up to 30 feet high and safely hold the mast in position, should the operator release the handle.



# THE PLAN

1. Replace ICE with Fuel Cell
2. Replace HID Lighting with LED or Plasma Light
3. Field Test Prototypes in CalTrans operations, LAX, SFO (TBD)
4. Mass Manufacture

# EXPECTED RESULTS

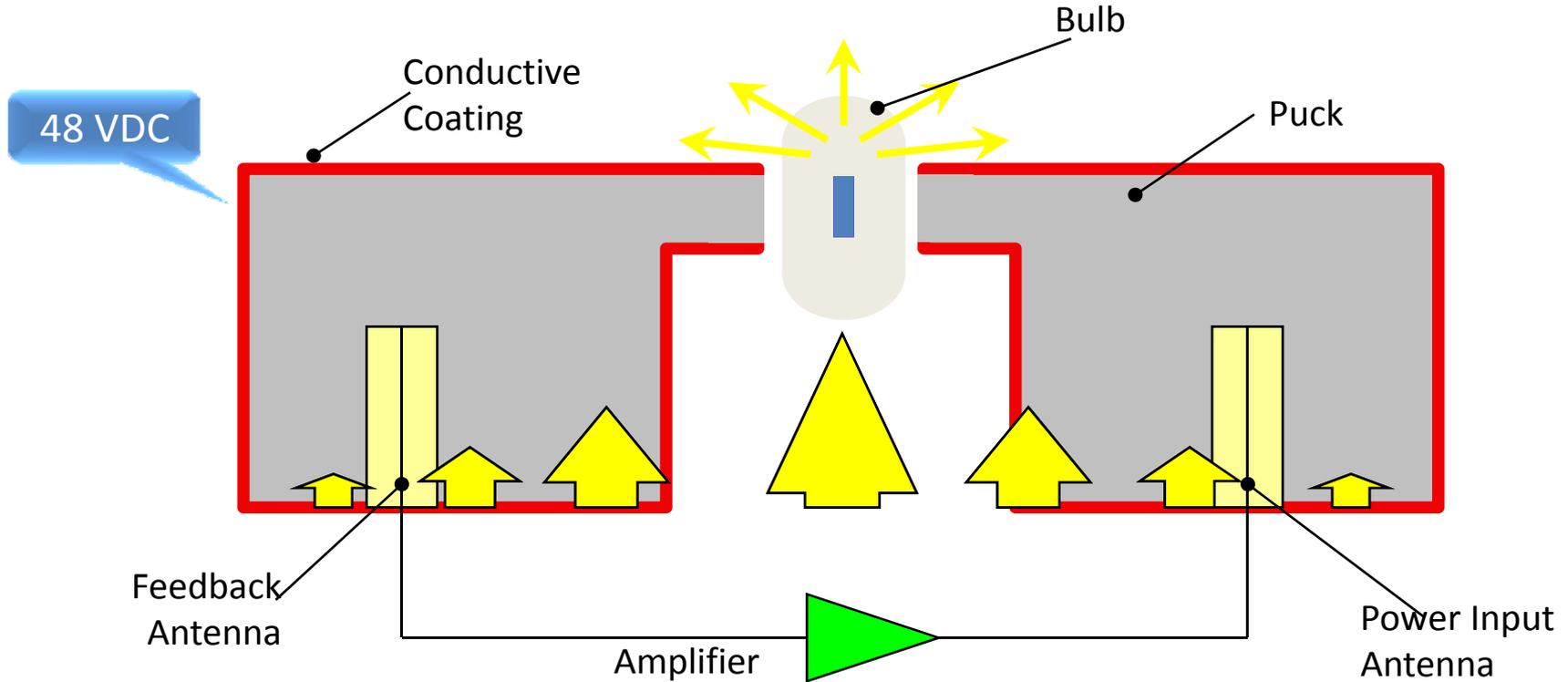
1. Very quiet operation
2. No CO<sub>2</sub> emission
3. No particulate emission
4. Saves 3285 gallons of diesel per unit per year
5. Saves 36.4 tons of CO<sub>2</sub> per unit per year if “green” H<sub>2</sub> is used
6. Expands market for fuel cells into construction industry
7. Complements H<sub>2</sub> Highways

# LUXIM<sup>®</sup>

State-of-the-Art Plasma Lighting



# How LUXIM's LIFI Technology Works



- 1) Amplifier feedback circuit establishes electric field
- 2) Field ionizes gas and creates plasma ⇒ Purple glow emission
- 3) Plasma vaporizes the salts ⇒ Blue light emission
- 4) Salts join the plasma ⇒ Powerful white light emission

# World Changing Potential in Street & Area Lighting

- ④ 50% system efficiency advantage to HID lamps and LEDs
  - Source efficacy
  - Fixture efficiency
  - Dimming to 20%; smart lighting
- ④ Long life / low maintenance
  - 30,000 hrs. life
- ④ Best color spectrum available
  - CRI 95



# State-of-the-Art PEM Fuel Cell Technology

Efficiency of Alteryg F.C. = 44% ✓  
Efficiency of Diesel Generator = 27%



5 kW Alteryg Systems Fuel Cell  
Certified ZERO Emission

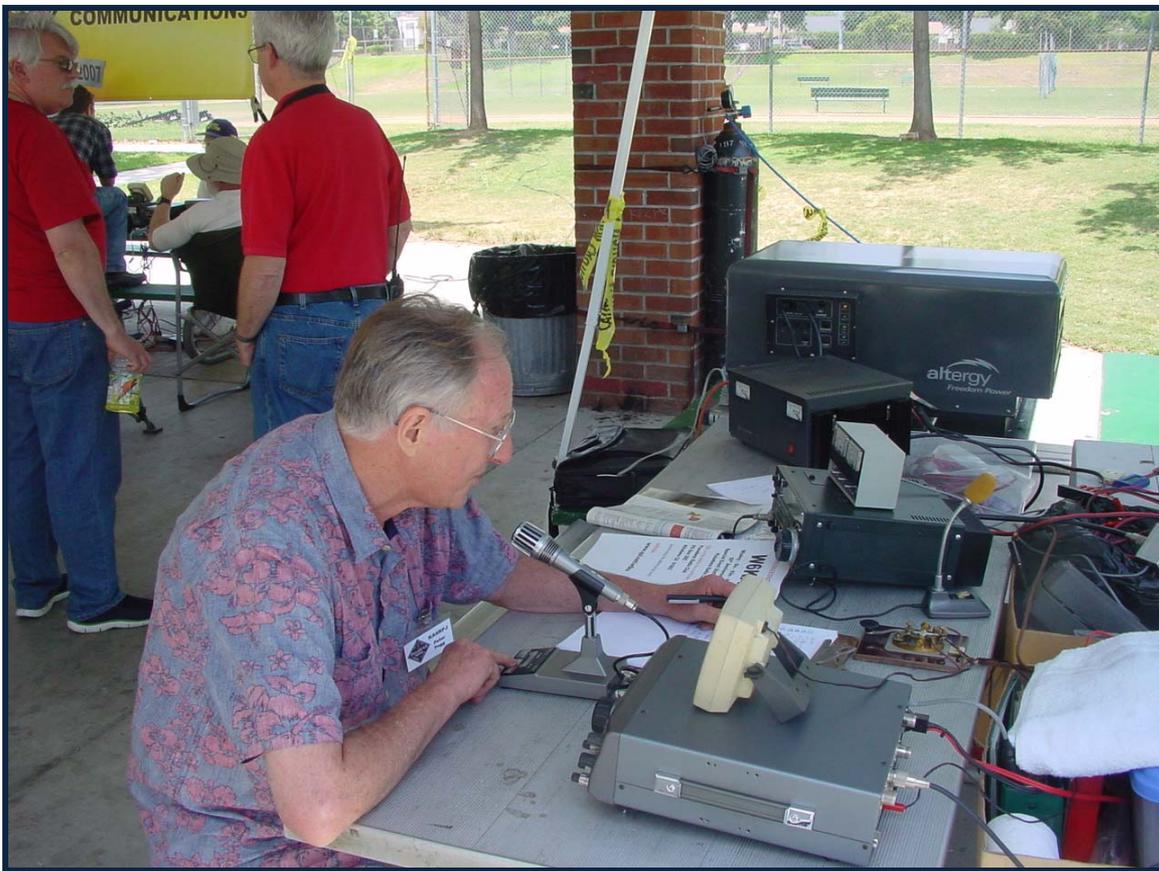
**Greater Overall System Efficiency due  
To Fuel Cell/Plasma Light Combination**

“Alpha” Prototypes to use high pressure H<sub>2</sub> storage in composite tanks



“Beta” versions to use advanced metal hydride storage of H<sub>2</sub>





Pasadena Radio Club Event  
Powered by 1 kW Fuel Cell—2007



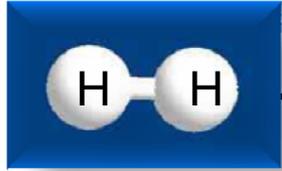
## Other Spinoff Uses Include:

- Highway Construction
- Building Construction
- Airport Operations
- FEMA
- Police/Fire Operations
- UPS
- Emergency Communications
- Home Emergency Power
- Disaster Recovery
- Trucking APU



**Public/Private  
Effort In  
Reducing  
Emissions by  
Demonstration  
of Technology  
For  
Commercial  
Product**

Hurricane Ike Recovery  
FEMA Camp—Galveston, Texas



# Use of Proposed CEC Funding

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- ✓ **Our team is seeking \$1.2 M in CEC funding to design, build and fully field-test 2 Metal Hydride H<sub>2</sub>/Fuel Cell Mobile Light Systems (“beta” systems), to allow a fully informed commercialization plan by MultiQuip.**
- ✓ 1 beta unit to be field tested in CalTrans Maintenance operation
- ✓ 1 beta unit to be field tested at LAX or SFO (TBD) in aircraft maintenance operations.
- Our industrial partners have already pledged \$264,000 in “in-kind” contributions to develop an “alpha” system based on high pressure storage of H<sub>2</sub>.
- Boeing has contributed additional \$100K (to Sandia) to initiate the project and conduct initial design studies on beta system.