

Demonstration of SOFC Generator Fueled by Propane to Provide Electrical Power to Real World Applications

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H2RA005

Overview

Timeline

- Project start date: 1/1/2010
- Project end date: 6/30/2014
- Percent complete: 100%

Budget

- Total project funding
 - DOE share: \$2,202,491
 - Contractor share: 2,497,475
 - DOE Share to Acumentrics: \$567,117
 - Acumentrics Share: \$567,117

Barriers

- Size & Weight Reduction
- Transportability
- Transient loads

Partners

- Acumentrics
 - Design/Build/Test
- NASCAR
 - Site logistics

Relevance-from Original Program

Relevance



- Project is focused on exploring the efficacy of replacing gasoline powered portable generators at large outdoor events and in first responder applications with propane powered fuel cells
- This project will further the development of emerging technologies including SOFC and propane fuel management that could be an alternative to gasoline powered generators
- The combination of a high efficiency fuel cell (SOFC) and a readily available fuel source (LPG) opens up many potential applications
- The ready availability of LPG worldwide for commercial and consumer applications eliminates the requirement for a hydrogen refueling infrastructure
- This project is funding development activities that could lead to near term commercialization of fuel cell technology in multiple applications where internal combustion engine- based generators have significant drawbacks

Basis of the Program

- This program started in June 2013 to complete a program started by Jadoo Power Systems. The premise was:
 - NASCAR is an industry lead on advancing sustainable products & technology looking for improved camera power technology
 - Acumentrics is focused on high efficient, clean power generation for remote & difficult applications.
- Based on discussions and a speedway visit with NASCAR, it was agreed that Acumentrics would:
 - Develop a 1000 Watt Cart Based Portable Generator (fueled by propane) for powering multi-camera sites and in-field auxiliaries
 - Develop a 250 Watt Man-Portable Generator (fueled by propane) for powering single camera sites
 - Deliver two 1000 Watt and two 250 Watt Generators
 - Demonstrate the unit at several NASCAR races

Program Scope

- Acumentrics to deliver two RP1000 and two RP250 systems for demonstration at three NASCAR races
- These units would be operated and supported by Acumentrics personnel
- NASCAR would be responsible for fuel delivery coordination and providing security access
- First demonstration at Daytona spring 2014

Program Benefits - NASCAR

- Demonstrate cutting edge green technology for broadcast camera power
- Validate reduced noise and vibration allowing closer integration between generator and camera
- Validate potential fuel savings and emission reductions at race events
- Demonstrate “smart” generator control for potentially improved camera and broadcast uptime
- Demonstrate improved race event safety by removal of fueling needs during events

Program Benefits - Acumentrics

- Demonstrate our latest generator products in a new potential market
- Gain greater field data to refine all product platforms
- Leverage public events to benefit both NASCAR and Acumentrics name & brand
- Leverage DOE funding to help commercialize all product platforms
- Place both NASCAR and Acumentrics in a favorable light allowing for potential future funding or support

Advantages of RP250 vs. Honda 3000is

■ Fuel Consumption-Honda

- Per NASCAR input, generators consumes ~5gal/10hr race or ~20 gal/race weekend (assumed operate 4 days)
- At \$3.63/gal that's \$73/generator or \$2190/30 deployed generators

■ Fuel Consumption-RP250

- Propane consumption of 2lbs/10hr race
- One 20lb bottle would last a race weekend
- Total cost of \$5/generator or \$150/ 30 deployed generators

■ Net Savings of over \$2000/race weekend or \$77,000 per season

Advantages of RP250 vs. Honda 3000is

■ Noise:

- Honda 3000: 58dB @ 23ft
- RP250: 58dB @ 2ft

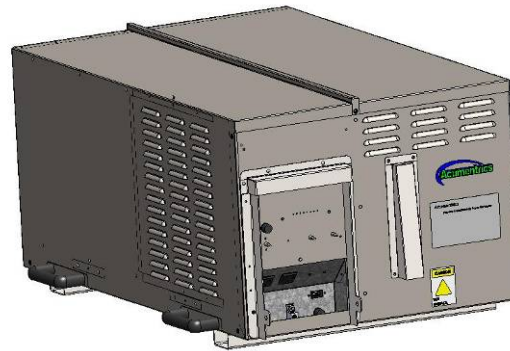
■ Vibration:

- Honda 3000-need to locate ~10' from camera
- RP250 could be mounted within 1-2 feet

■ Remote Start & Control

- Honda 3000: Not Applicable
- RP250: Control from broadcast compound or smart phone across cellular or fiber network

Dimensional Comparison



	RP250	Honda 3000
Width	20"	17.5"
Height	15.5"	21.9"
Length	32"	25.8"
Weight	125lbs	134lbs

Physical Size & Weight Reductions

Model	L (in)	W (in)	H (in)	Wgt(lbs)
RP250	32	20	15.5	127
RP500	39	22	22	300
RP1000	39	28	25	350

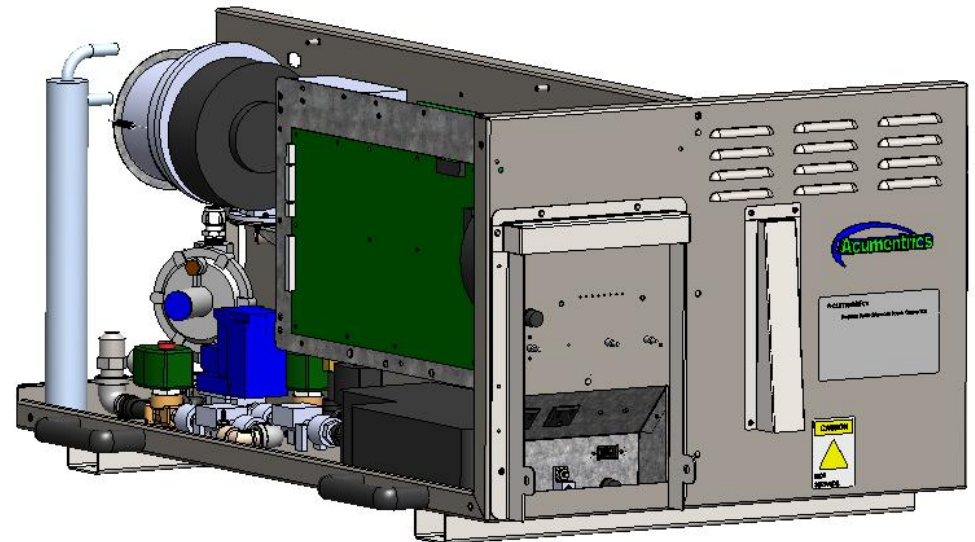
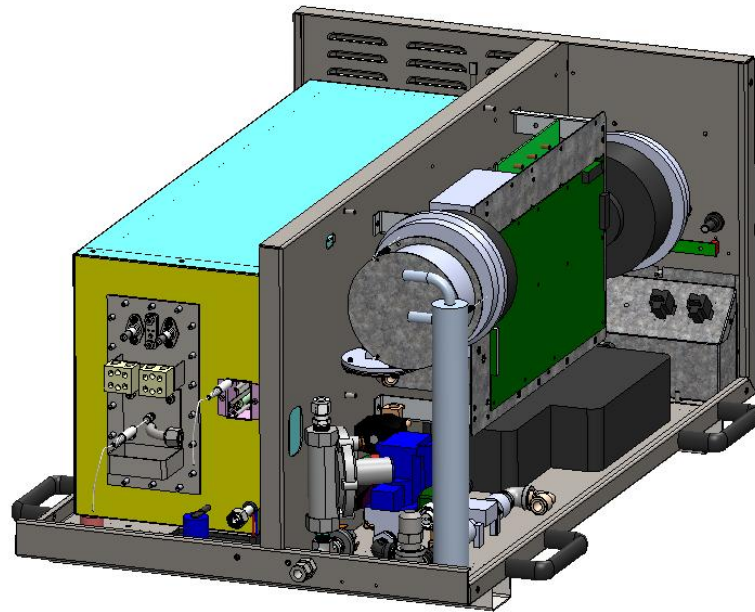


- Latest Generation is 47% smaller in volume over RP250/500 Model
- 58% lighter than previous generation and in-line with 2 man portable.

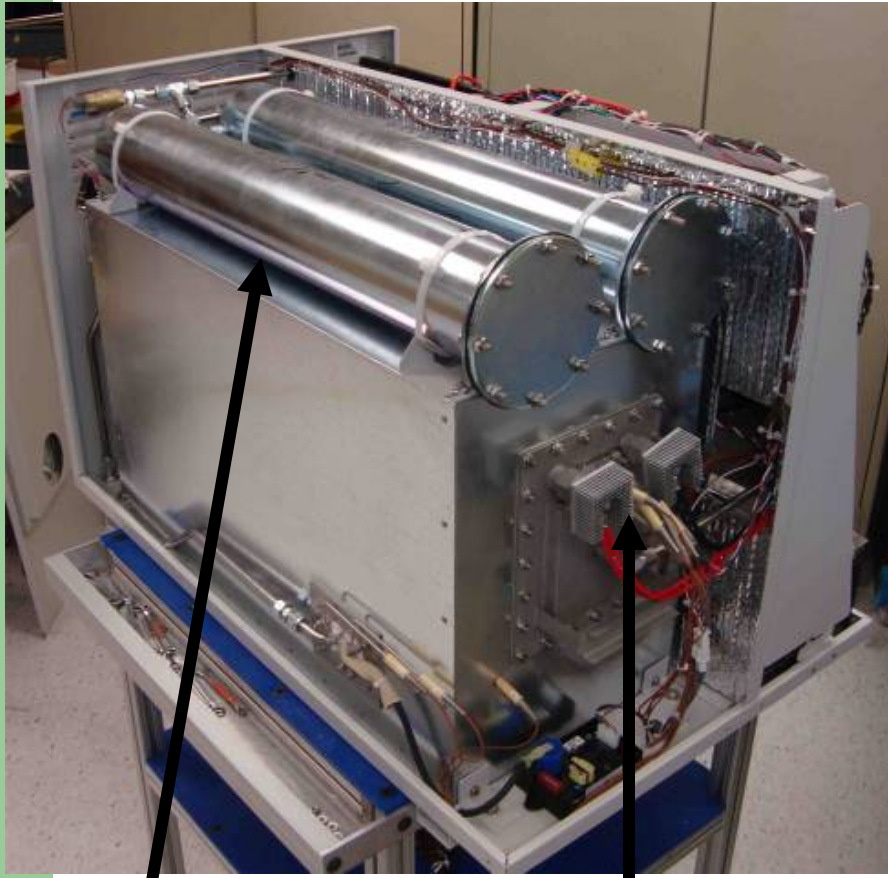
Design Activities

- Scale existing 20 cell bundle to 10 cells (250 Watt) and 48 cells (1000 Watt)
- Design Fuel Cell Modules to Accommodate 10 and 48 cell bundles
- Design propane delivery system including desulfurizers
- Integrate RP system with AC Inverter
- Tailor firmware for new power levels, AC output, variable loads and automatic operation
- Design 1000 Watt cart and Fuel Cell and Propane Enclosures
- Design 250 Watt Enclosure
- Integrate Li Ion batteries into 250 Watt system

RP250 Design

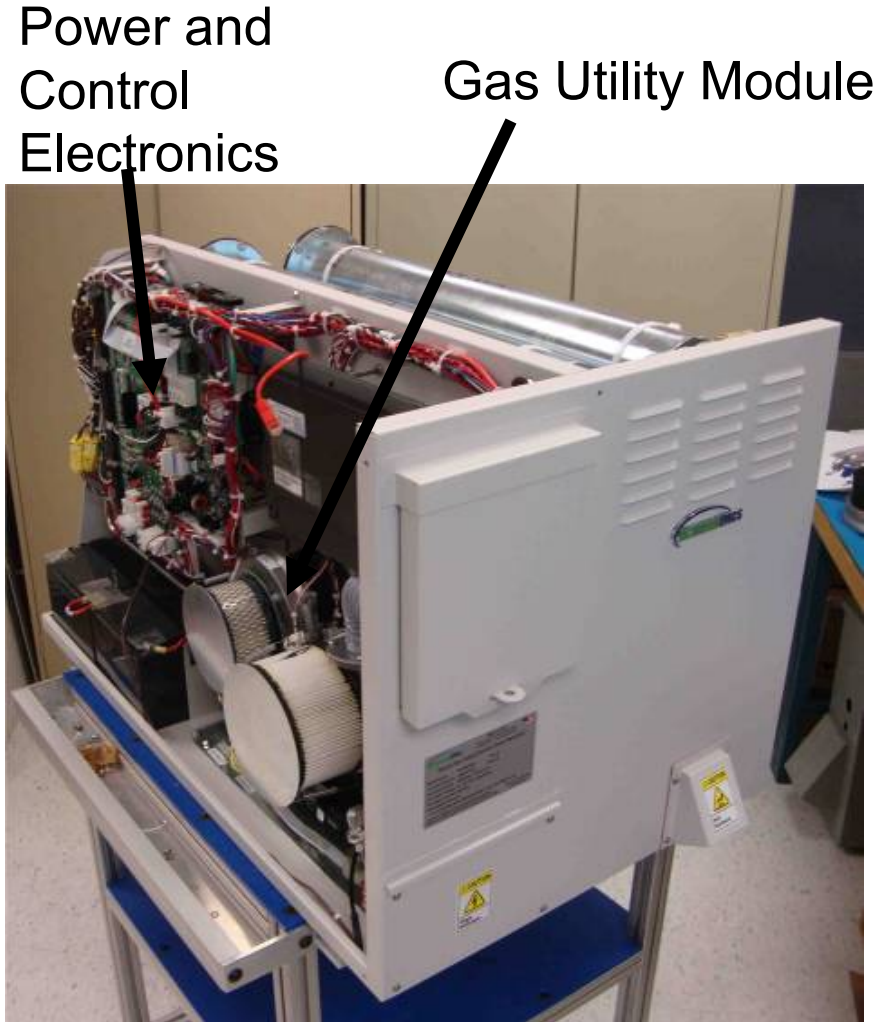


Basic RP1500 Unit



Desulfurizer
Filters

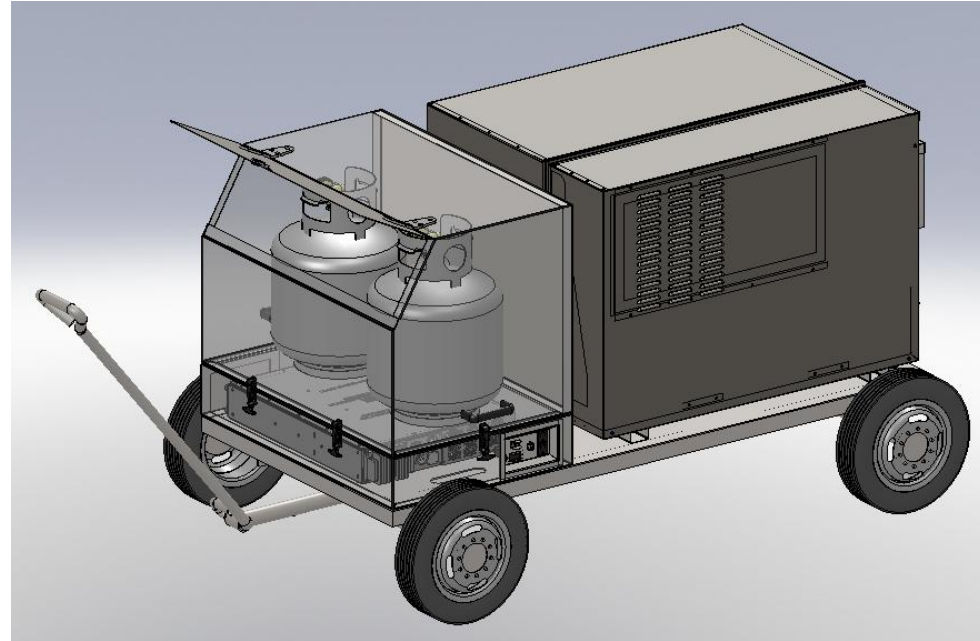
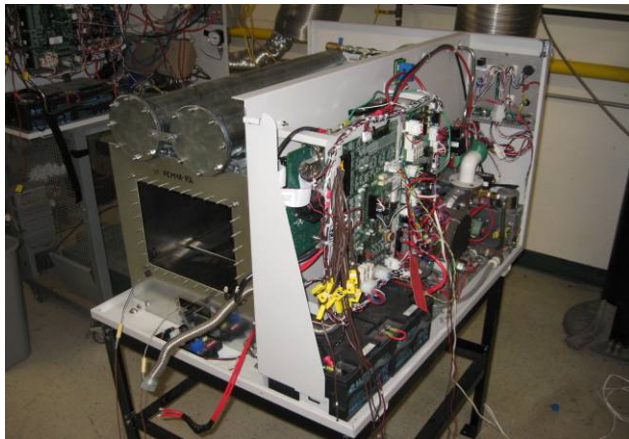
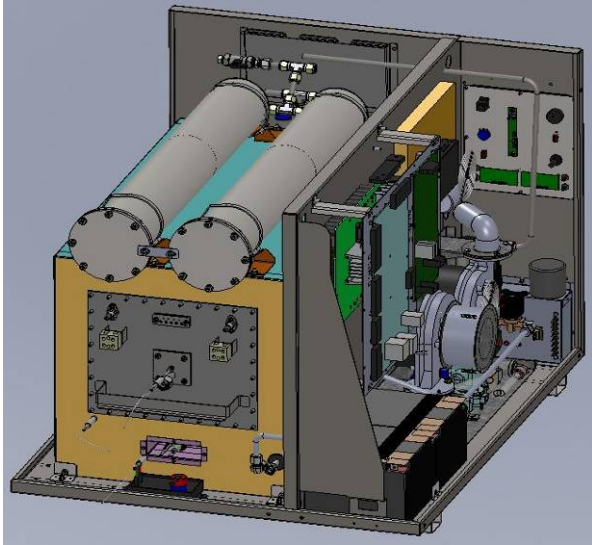
Fuel Cell
Bundle



Power and
Control
Electronics

Gas Utility Module

RP1500 Integrated Design



Rolex24-Trophy Stand Power

- The RP1000 was demonstrated near the trophy stage.
- Unit was trailer towable and contained ~1 week of fuel supply
- Trailer Updates made before 500.



Powering Boom Camera-Turn 2



- The RP250 powered the camera, articulating arm, and LCD display.
- Load ranged from 15-20W to ~200W.
- No issues load following over the course of ~8hrs of filming during Rolex24.

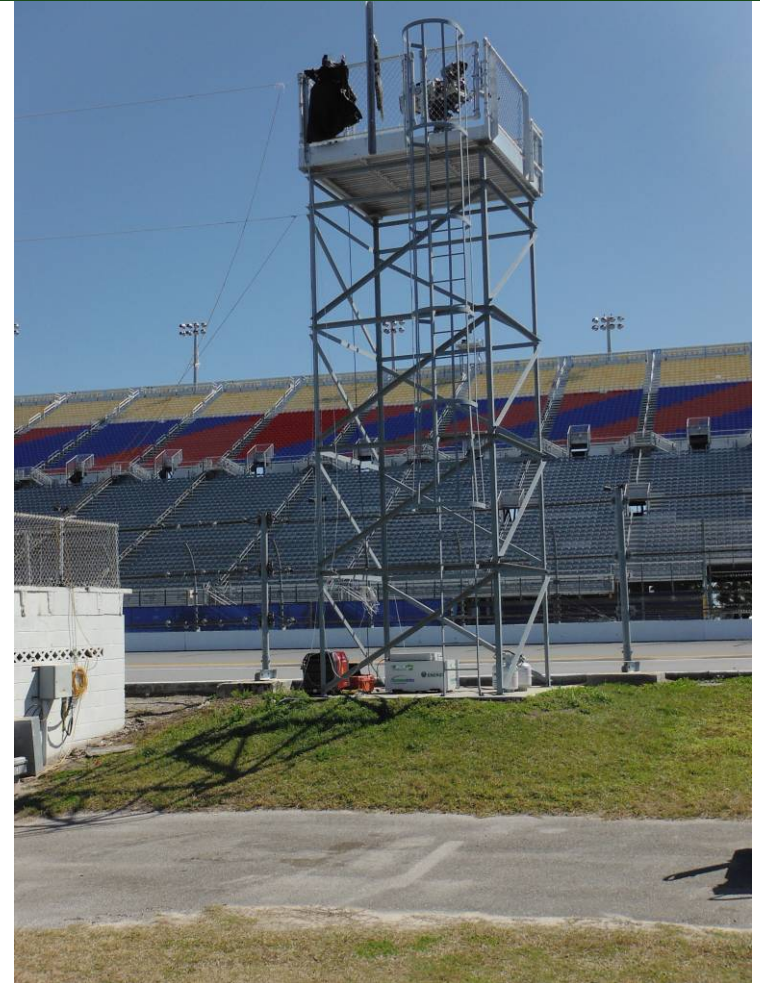
Powering Manual Camera-Turn 3



- The RP250 powered the manual camera and LCD display.
- Load around 150-180W.
- Operated over a 2 week period culminating with the Daytona 500.

2 Week Extended Run During Speed Weeks

- The RP250 powered the manual camera and LCD display.
- Load around 150-180W.
- Utilized 4lbs/day propane.



1000W Operating Near Pit Row



- Two 1000W AC units were located on the track-one exiting pit row & one at the flag stand
- These units were primarily utilized for stationary point of use cameras
- Limited data was obtained to compare fuel use savings and performance gains.

Summary

- The RP250 units were proven to successfully power both manual and articulating cameras around the track.
- Quoted fuel reductions to less than 5lb propane/day were validated.
- Dispatching and monitoring of the units from the TV compound through cellular communication was demonstrated.
- Ruggedness of transport by truck/golf cart/towed cart was proven with no detectable damage to fuel cell stack or units.
- Noise levels at or below background were demonstrated and proven to be an asset during non-race times.

Acknowledgements



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