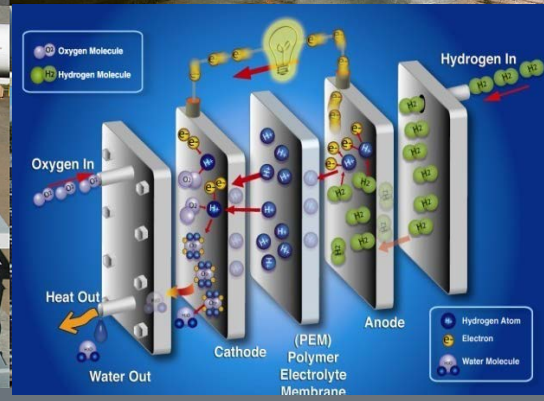
Fuel Cells at NASCAR

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Catherine Kummer – NASCAR Green

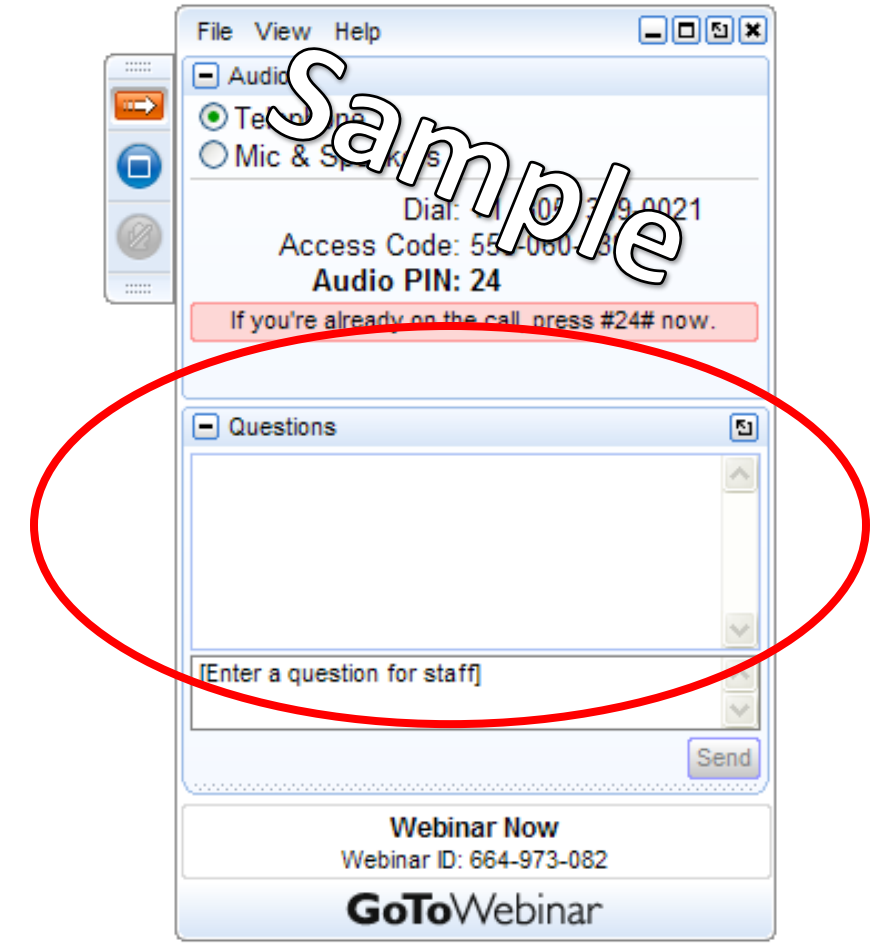
Norm Bessette – Acumentrics

Ned Stetson

U.S. Department of Energy
Fuel Cell Technologies Office

Question and Answer

- Please type your question into the question box




NASCAR®
GREEN™

Selected Milestone Accomplishments

- 5 years of NASCAR Green with now most impactful sustainability platform in history of U.S. based on numbers; most impactful in sports
- 75% of avid NASCAR fans are now aware of NASCAR green and believe the sport cares about the environment
- NASCAR fans are now 100% more likely than nonfans to view their household as very green and always looking for ways to positively impact the environment
- Nearly 70% more likely than non-fans to support the use of ethanol blended with gasoline to fuel NASCAR race cars
- More than 50% more likely to support the use of ethanol blended with gasoline to fuel their own car
- Forty percent (40%) more likely to support the use of ethanol blended with gasoline to fuel cars on the road to increase U.S. energy independence
- Grew from zero to 25 NASCAR Green partners across 12 new partners and 13 engaged from the existing base

NASCAR Green Initiatives and Messaging

Conservation of the Environment

Job Creation

Strengthening American Energy Independence

Largest and Most Diverse Recycling Program in Sports

Bottles and Cans
20 million recycled total to date

Cell Phones

Tires
605,000 recycled total to date

Automotive Fluids
1MM gallons recycled total to date

Car Batteries

Car Recycling
96% materials recyclable per car

NASCAR GREEN

Most Visible Biofuels Program in the World

6 million miles raced on Sunoco Green E15 in 2014

Largest Tree Planting Program in Sports

- Over 267,000 trees planted to date
- Offsetting all NASCAR racing already for the next 18 years
- Over 200,000 more trees to be planted in 2015

Arbor Day Foundation

ups

VIRGINIA DEPARTMENT OF FORESTRY

NASCAR GREEN

Largest Renewable Energy Projects in Sports

Pocono Raceway

Iowa Speedway

Sonoma Raceway

UPS Trackside Services Hauler

Watkins Glen International

Michael Waltrip Racing Team Shop

NASCAR GREEN

NRDC
THE EARTH'S BEST DEFENSE

U.S. DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

NASCAR GREEN

U.S. Department of Energy and NASCAR MOU

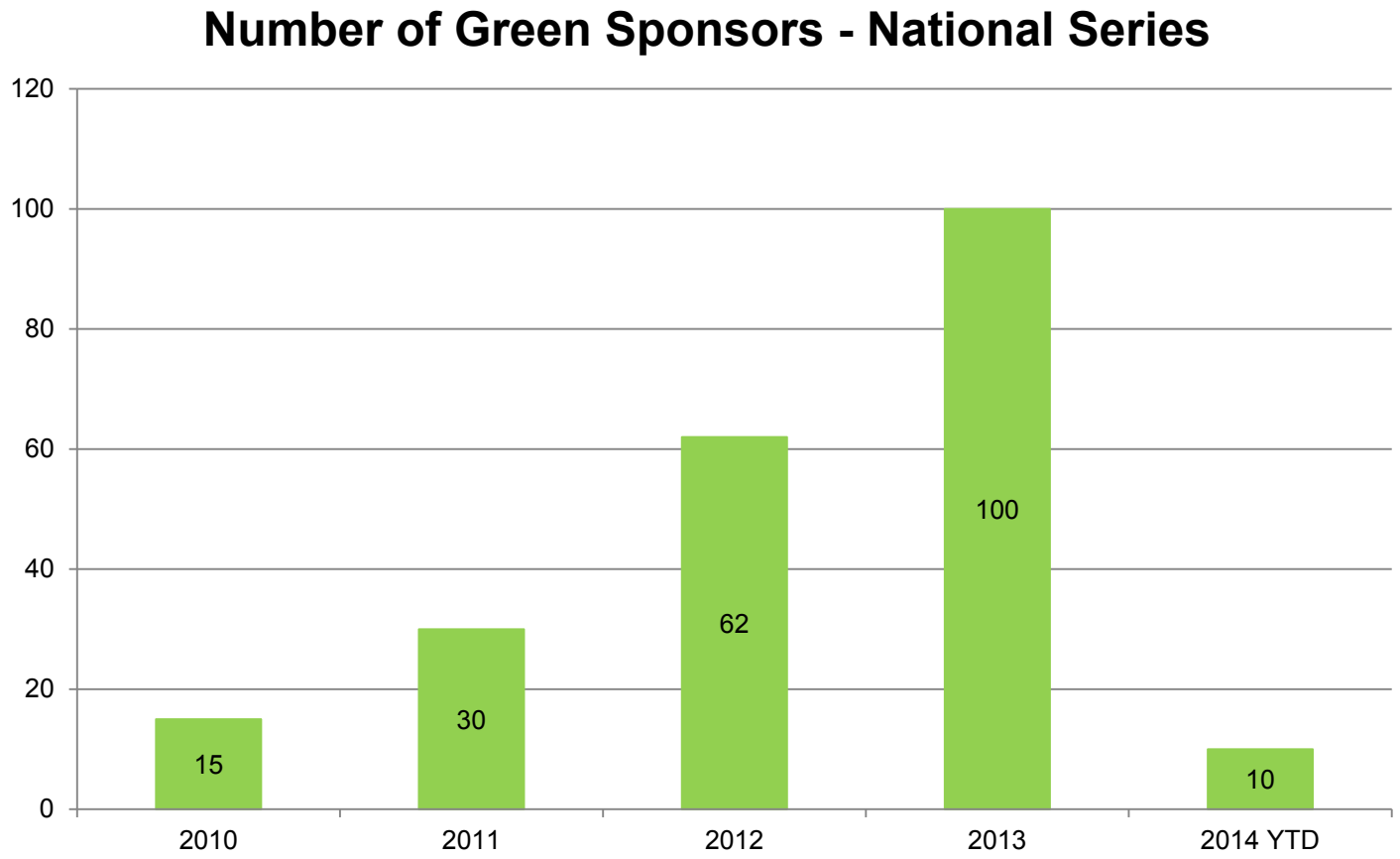
Areas of Focus:

- **Clean Energy Deployment and Utilization**
  - Example: NASCAR has joined the Workplace Charging Challenge with the installation of 20 Eaton EV Charging Stations
- **Collaborative Research, Development and Technology Commercialization**
  - Example: Beta-test of solid oxide fuel cell technology at Daytona 500 and Rolex 24 in 2014
- **Community Outreach and Education**
  - Promotion of platforms and programs digitally, e.g. solid oxide fuel cell test supported with NASCAR social media and online channels – **over 4.5 million followers**

NASCAR Green Partners

** Interbrand Top 100*

Continuing 90% CAGR Team Sponsor Growth



Includes Liberty Tire Recycling (D. Wallace, Jr.), Eaton (Harvick, NNS), American Ethanol (A. Dillon), Blue Jeans Go Green NNS Race - Phoenix

Examples of NASCAR Green Activation

NASCAR GREEN

NASCAR TV Viewership and Fan Demographics

2013 NASCAR Series and Ancillary Programming Viewership

- Nearly 100 million unique viewers tuned in to NASCAR in 2013 and nearly 70 million tuned into the NASCAR Sprint Cup Series races.
- NASCAR is the dominant regular season sport from February – July.

Source: The Nielsen Company. Results reflect Live + Same Day data stream.

The NASCAR Fan Base

- Gender: 63% male / 37% female
- Age: 45% of NASCAR fans are 18-44 (96 index vs. U.S. pop)
- Income: 54% of NASCAR fans earn $50,000+ (104 index vs. U.S. pop)
- Family: 38% of NASCAR fans have children under the age of 18 (97 index vs. U.S. pop)
- Geographic regions: NASCAR fans live in regions that mirror the U.S. population
- Minorities: 1 out of 5 NASCAR fans is multicultural

Source: Scarborough (USA+ Release 1 2012)

NASCAR Green Communications Strategy

Broadcast	Earned Media	Digital Media

TV and Radio

Dedicated NASCAR Green TV Spots

THE WALL STREET JOURNAL

Bloomberg

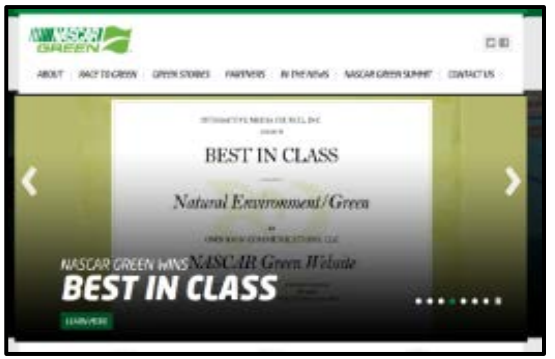
USA TODAY

Forbes

Bloomberg

THE HAYS ADVANTAGE

Online/Social



www.NASCAR.com/Green

@NASCARGreen

Selected Future Initiative Areas

Technologies ready for broad adoption/testing in NASCAR:

- Further deployment of fuel cell technologies – power generation
- Smart Grid Technologies/Further Energy Management
- Further growth in solar and renewable energy
- Specialty applications for water purification and other field operations
- LED Lighting – Track and garage lighting, mobile lighting, broadcast compound
- Next Generation Biofuels
- Electric Vehicles – Racing Series
- Natural Gas – Power generation at-track and in NASCAR broadcast compound, pace cars, etc.
- Agricultural Efficiency

Acumentrics
TRUSTED POWER INNOVATIONS

Demonstration of SOFC Technology Powering Cameras for NASCAR

Basis of the Program

- NASCAR is an industry lead on advancing sustainable products & technology
- Acumentrics is focused on high efficient 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

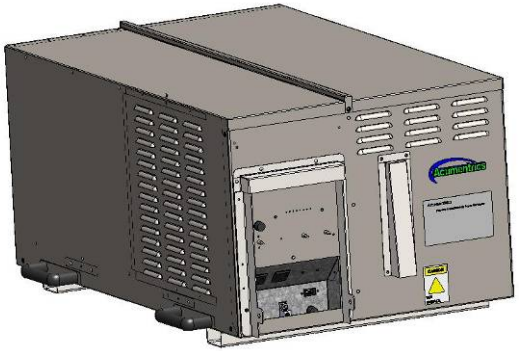
Advantages of RP250 vs. Honda 3000is

- 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

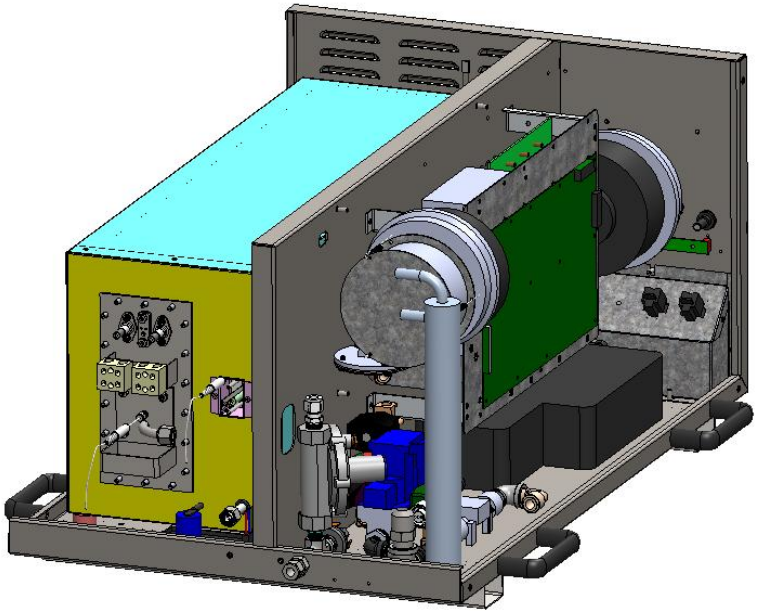
Model	L (in)	W (in)	H (in)	Wgt(lbs)
RP250	32	20	15.5	127
RP500	39	22	22	300
RP1000	39	28	25	350

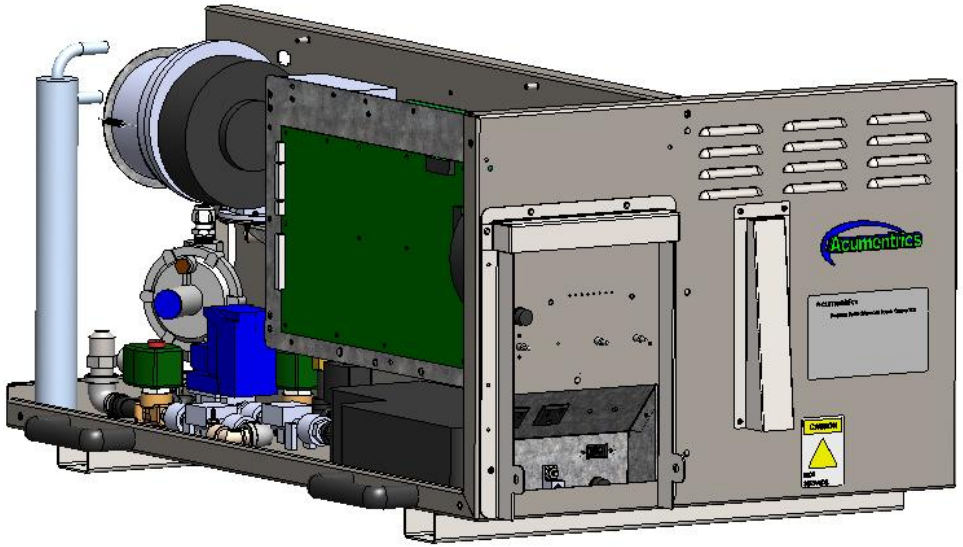
- Latest Generation is 47% smaller in volume over RP250/500 Model
- 58% lighter than previous generation and in-line with 2 man portable.

Design Activities

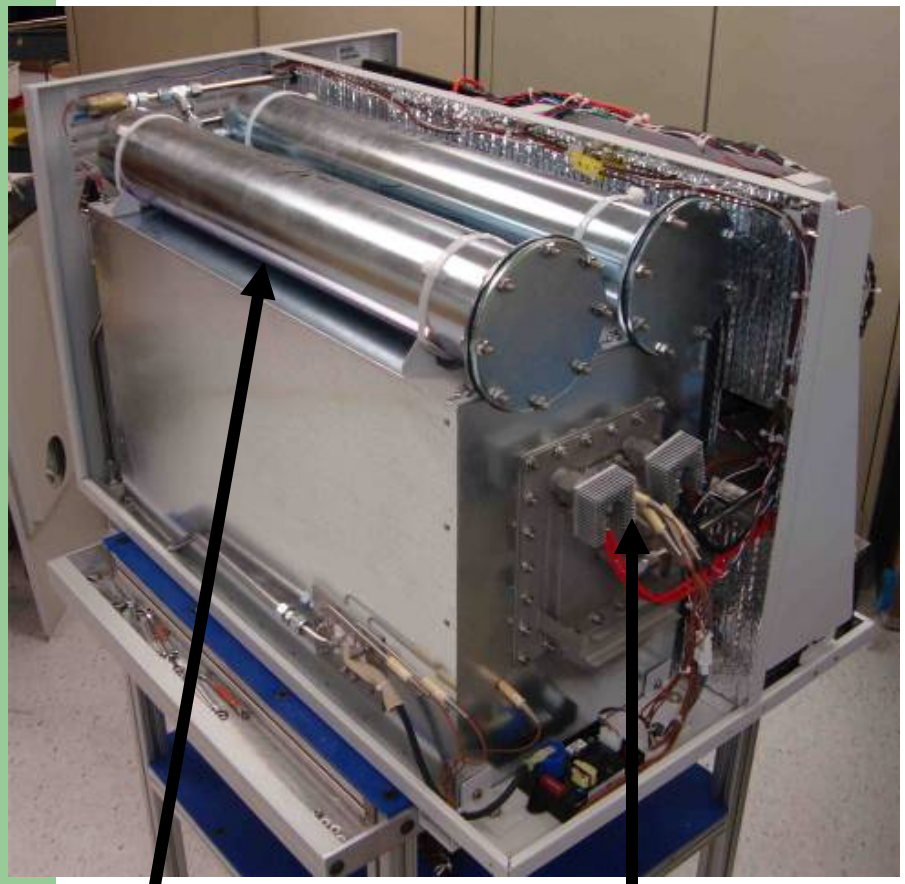
- Scale existing 20 cell bundle to 10 cells (250 Watt) and 48 cells (1000 Watt)
- Design Fuel Cell Modules to Accommodate 10 and 48 cell bundles
- Design propane delivery system including desulfurizers
- Integrate RP system with AC Inverter
- Tailor firmware for new power levels, AC output, variable 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

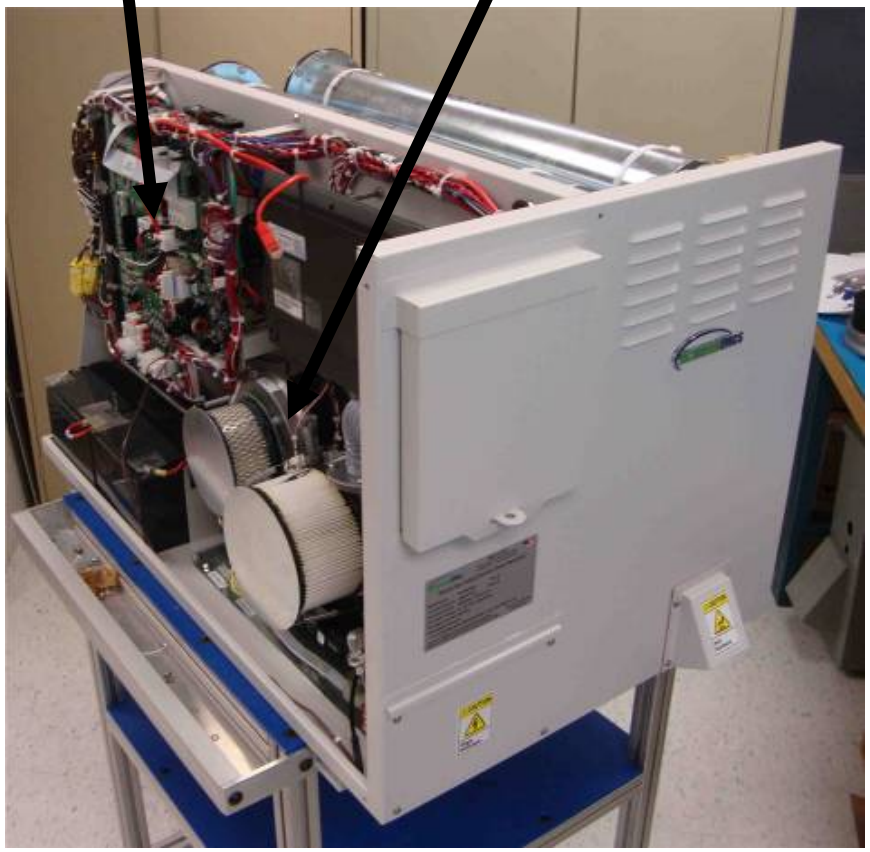
RP250 Design





Basic RP1500 Unit





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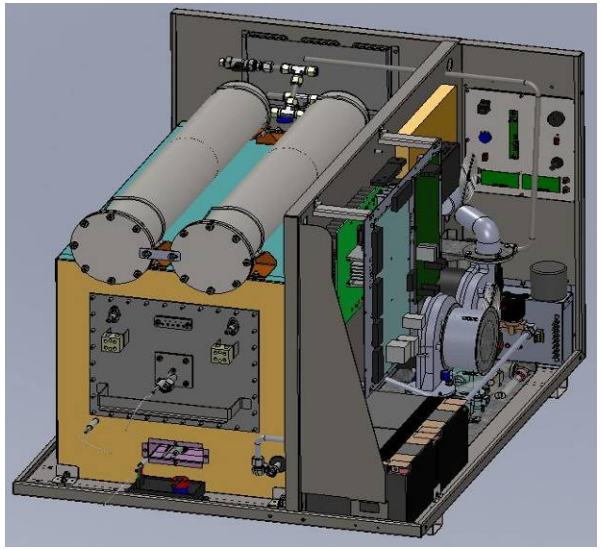
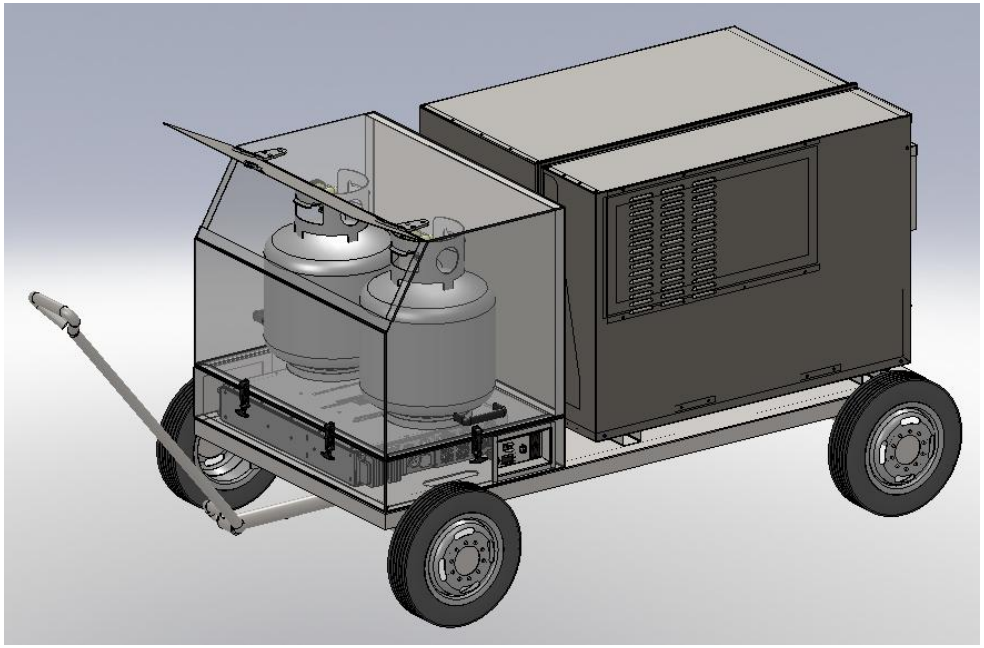
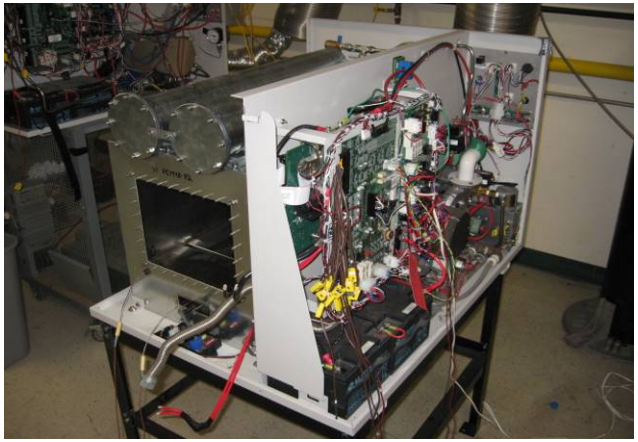
Trusted Power Innovations

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.

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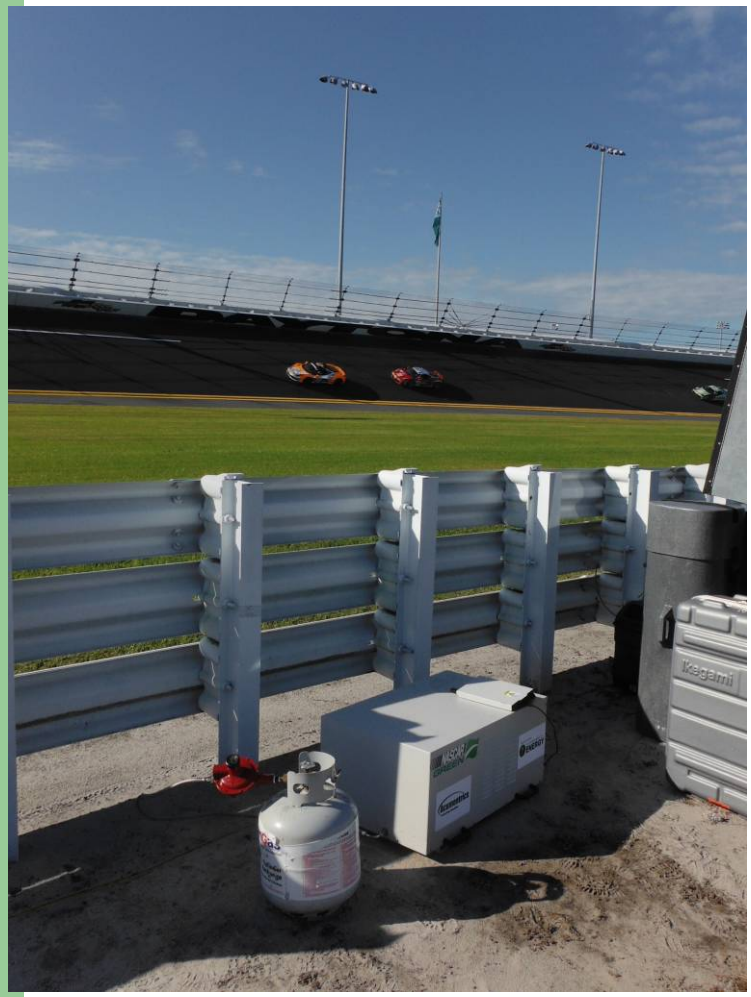
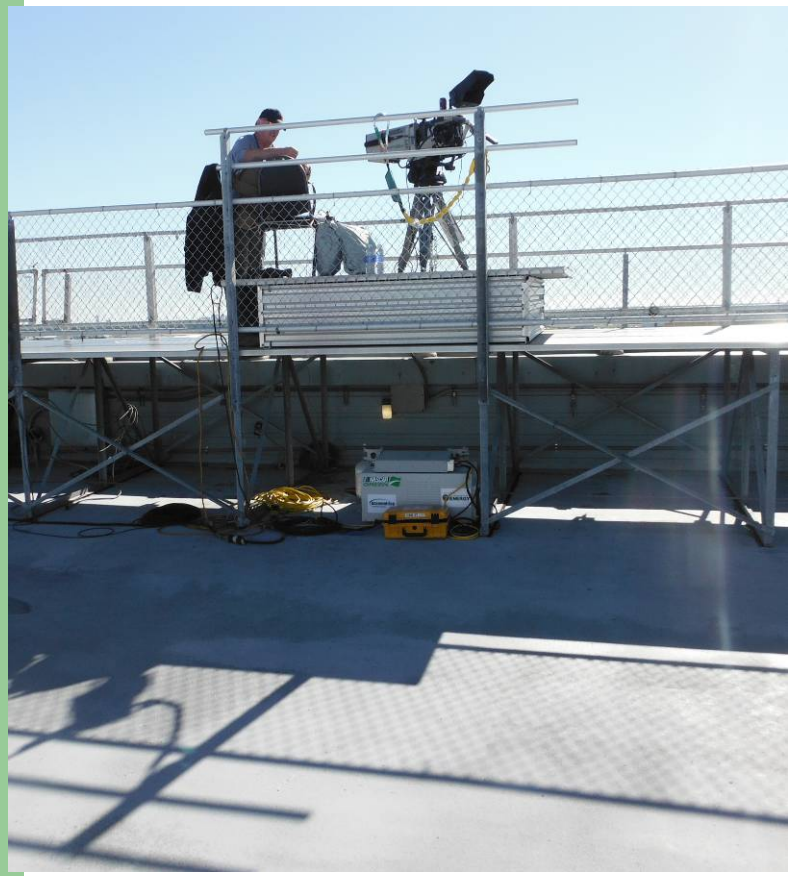
Field Trials

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.

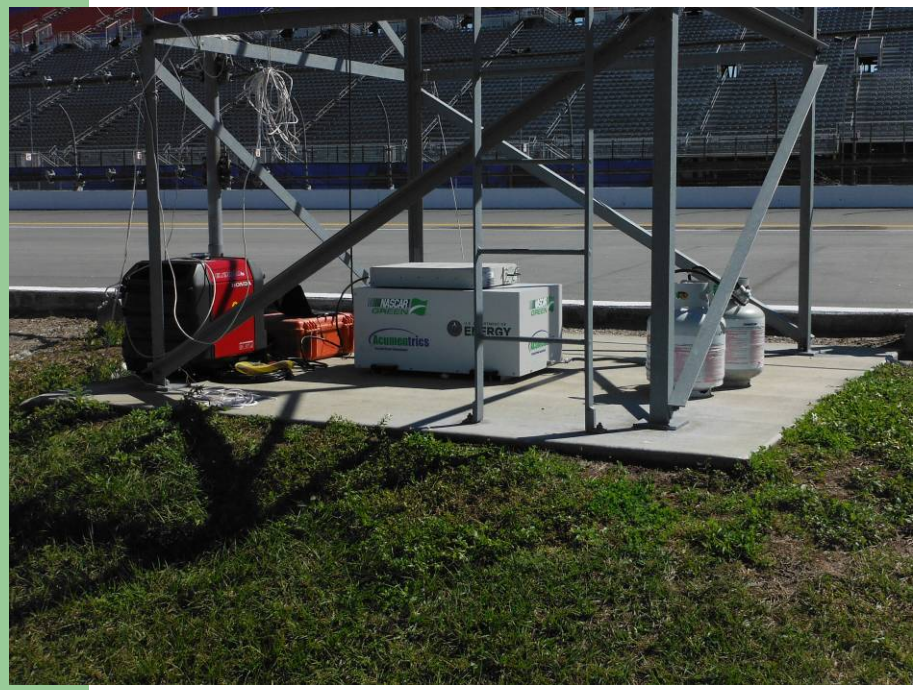
Powering Manual Camera-Turn 3

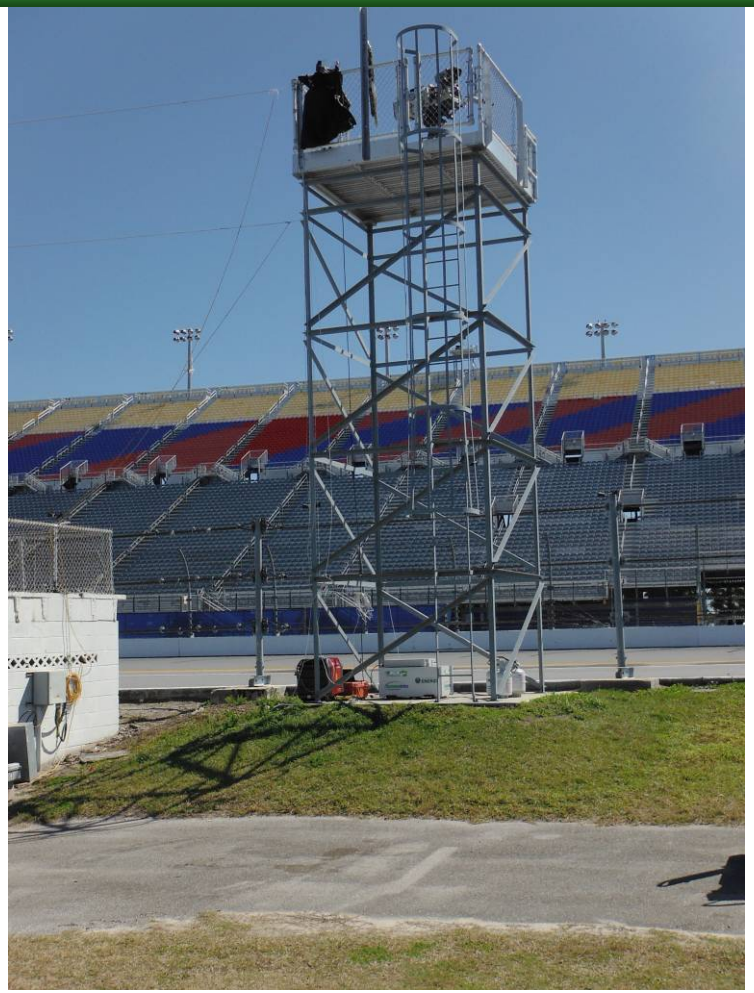


- The RP250 powered the manual camera and LCD display.
- Load around 150-180W.
- Operated over a 2 week period culminating with the Daytona 500.

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.

Conclusions

- 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.

Required Effort for Greater Deployment

- Unit Cost Reduction – present price would require a 5-7yr ROI based on fuel savings-need to improve this metric.
- Fuel monitoring – assuring what amount of propane is in the bottle and rate of consumption is still very manual. Greater automation is needed for full dispatch capability.
- Extended Trials – Units were tested over a 1 and 2 week period but logistical issues of packaging, transport, and fuel delivery need better data.

Acknowledgements

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Thank You

Ned.Stetson@go.doe.gov

hydrogenandfuelcells.energy.gov