JCS PHEV System Development

USABC Li-Ion PHEV Contract – P.O. 08-2047

U.S. Department of Energy Merit Review

Scott Engstrom
Johnson Controls – Saft

March 20th, 2009

Project ID: es_06_engstrom

This presentation does not contain any proprietary, confidential or otherwise restricted information.

Overview

Timeline

- Project Start – June, 2008
- Project Finish – June, 2010
- Percent Complete – 38%

Budget

- Total Project Funding - $8,211K
  - JCS Share 50%
- Funding Received in CY08
  - $1080K
- Funding for CY09
  - $2,012K (on track)

Barriers

- System energy density of present systems is too low
- Cycle-life in charge-depleting and charge-sustaining modes
- High cost of meeting performance targets

Partners

- Johnson Controls and Saft
- USABC Program Lead: Renata Arsenault
- DOE Contract Manager: David Howell

Objectives

- Develop Lithium-Ion PHEV Systems for 10 and 40 mile all-electric range applications.
- Demonstrate cell and system designs to meet program USABC targets.
- Report on thermal management modeling approaches for air-cooled and liquid cooled approaches.
- Characterize cathode technologies and other materials for PHEV applications.

Milestones

- Ship Baseline 10-mile all-electric range system for testing – *Complete*
- Submit abuse tolerance test summary for materials selections– *In Progress*
- Deliver baseline high-energy cells for testing (June, 2009) – *In Progress*
- Deliver cell technology performance characterization comparison (July, 2009) – *In Progress*
- Deliver 10 and 40-mile thermal management design review summary (Oct, 2009) - *In Progress*

Approach

- Cell design development will leverage existing hardware and focus on materials selection to optimize performance.

- System development approach will utilize core sub-assemblies and strategically address those areas which will best improve the energy density and cost.

- Manufacturing study to improve design and assembly efficiencies.

Technical Accomplishments/Progress/Results

- Assisted USABC in assessing alternate abuse tolerance testing methods
- Development of core PHEV system software
- Thermal Management model development for air and liquid cooling applications
- Development of alternate cell technologies for comparison
- Updated Cost Model
- Identification of assembly process improvements

Future Work

2009

- Continue to refine cell performance for 10 and 40-mile applications
- Develop 10-mile design for optimized cost/size
- Complete study of various cell technologies for performance and reliability.

2010

- Build and deliver 10-mile design
- Develop and deliver 40-mile design

Summary

- JCS has built research teams in Europe, North America and Asia with experience on a broad range of battery technologies.
- Ability to leverage years of Automotive Experience and a world-class supply base with parent company.
- Used USABC HEV development program to get head start in this PHEV program for systems design/development and manufacturing.
- Cell manufacturing capability developed in US.

Summary Table

USABC Goals for Advanced Batteries for PHEV's (End of Life Energy Storage Systems for PHEVs)			
Characteristics - EoL	units	High Power/ Energy Ratio Battery	High Energy/Power Ratio Battery
Ref. Equivalent Electric Range	miles	10	40
Peak Pulse Discharge Power - 2 Sec	kW	50	46
Peak Pulse Discharge Power - 10 Sec	kW	45	38
Peak Regen Pulse Power - 10 Sec	kW	30	25
Available Energy for CD (Charge Depleting) Mode, 10 kW Rate	kWh	3.4	11.6
Available Energy for CS (Charge Sustaining) Mode	kWh	0.5	0.3
Max. round-trip energy Efficiency (USABC HEV cycle)	%	90	90
Cold Cranking power at -30 Deg C, 2 Sec - 3 Pulses	kW	7	7
CD Life/Discharge Throughput	Cycles/MWh	5000 / 17	5000 / 58
CS HEV Cycle Life, 50 Wh Profile	Cycles	300,000	300,000
Calendar Life, 35 Deg C	year	15	15
Maximum System Weight	kg	60	120
Maximum System Volume	Liter	40	80
Maximum Operating Voltage	Vdc	400	400
Minimum Operating Voltage	Vdc	<0.55 x Vmax	<0.55 x Vmax
Maximum Self-Discharge	Wh/day	50	50
System recharge Rate at 30 Deg C	kW	1.4 (120V/15A)	1.4 (120V/15A)
Unassisted Operating & Charging Temperature Range	Deg C	-30 to + 52	-30 to + 52
Survival Temperature Range	Deg C	-46 to + 66	-46 to + 66
Maximum System Production Price, @ 100k units/year	$	$1,700.00	$3,400.00

Preliminary results planned for late 2009.